

Rapid damage control and more: how green leaf volatiles protect against biotic and abiotic stresses

Green leaf volatiles (GLV), the typical “green” smell of cut grass, have been found to be potent signals between plants, where they induced an array of responses all aimed to protect plants against damaging forces like insect herbivory and pathogen infections, but also against abiotic stresses like cold, drought, and heat. The focus of our research has mainly been on the effects of these compounds against insect herbivory, where we found that they protect plants by priming or preparing them for impending herbivory resulting in significantly reduced damage. However, more recently we also found that many caterpillars have developed mechanisms to suppress the production of GLV, further adding to the complexity of responses to these common plant compounds.

We have further shown that GLV can provide significant fortification against cold stress damage. Maize seedlings treated with GLVs, in particular, Z-3-hexenal (Z-3-HAL) had significantly improved cold stress resistance, likely through increased transcription of genes that help to increase cellular integrity. This resulted in significantly less damage, and even increased growth after a cold stress episode when compared to non-HAL treated plants.

While the biosynthesis of these compounds is generally well understood, little is known about the qualities and quantities that are released by different plant species, nor is it known if release patterns can be associated with different clades of plants. By analyzing more than 60 plant species to date we found major differences in the quantity and quality of those compounds between different plant species; however we did not find any major patterns that would associate specific GLV release with distinct clades of plants. We therefore hypothesized that ecophysiological considerations related to biotic and abiotic stresses may be more relevant for the capacity to produce GLV rather than phylogenetic relationships. These and other findings covering the last 20 years will be discussed.