



Chemical Ecology of Northern White Cedar: Identifying Volatile Compounds Responsible for White-Tailed Deer Browse Resistance



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Background

Northern white cedar (*Thuja occidentalis* L.) is an important tree species notable for its use as windbreaks in agroforestry systems. Difficulties in natural regeneration of northern white cedar have caused concerns for the long-term sustainability of the species. White-tailed deer (*Odocoileus virginianus* Zimmerman) have been identified as a major impediment to white cedar seedling regeneration. Not only does heavy browsing by white-tailed deer result in white cedar damage, but it also disrupts the natural growth and regeneration of cedar.

Knowledge about the interaction between white-tailed deer and northern white cedar is limited, especially regarding the reasons for preferential browsing among cedar individuals.

This research investigates the relationship between plant-produced volatile compounds, known as phytochemicals, and deer browse on northern white cedar.



Objective

- Identify phytochemicals responsible for resistance to deer browse in northern white cedar
- Extract, purify and test the applicability of these compounds as natural-based deer repellents
- Monitor field-based plantings of experimental cedar progeny for deer browse activity

Methods



1. Collect and Propagate Cedar Seedlings From Browsed and Non-Browsed Parent Trees

- Leaf and cone material collected
- Collections from 3 sites located in Wisconsin and Indiana
- Offspring propagated from collected cones and grown under greenhouse conditions



2. Identify and Quantify Phytochemicals in Northern White Cedar Progeny

Using Gas chromatography-mass spectrometry:

- Examine differences in leaf chemical composition between cedar that have been browsed by deer and those that haven't
- Identify phytochemicals using chemical profiling methods via NIST GC-MS library matching
- Quantify phytochemicals in cedar that have potential for deer browse resistance using analytical standards



3. Monitor Field Plantings of Cedar Progeny

- Cedar grown in greenhouse transplanted and grown in field
- Seedlings are monitored for deer browse activity using trail cameras
- Data used to confirm deer browse resistance capability and examine the heritability of resistance



4. Extract, Purify and Test Phytochemicals as Natural-Based Deer Repellents

- Extract and purify potential deer browse resistance chemicals from cedar leaf material
- Test viability of these chemicals as deer repellents through application in feeding trials of captive deer

Preliminary Results

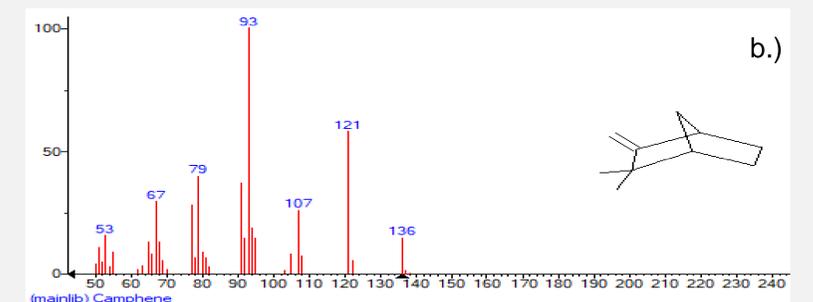
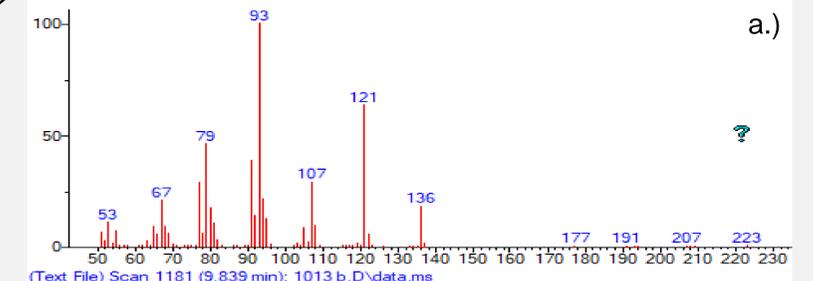


Figure 1. Positive identification of camphene in cedar samples using chemical profiling by matching a.) sample GC-MS spectra with b.) NIST library spectra

- Identification of 26 phytochemicals in cedar samples
- 18 phytochemicals chosen for further quantification
- Established field trials at 2 locations in Wisconsin

Moving Forward

- Quantification of selected cedar phytochemicals
- Feeding trials of captive deer using extracted chemicals
- Collection and analysis of trail camera video and photos
- Integration of XCMS for further chemical analysis
- Expanding collaboration efforts with local, national and international researchers studying the effects of white-tailed deer on northern white cedar (e.g. Cedar Club)