

# Characterization of Variation and Mechanisms of Resistance of Ash to Emerald Ash Borer

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## INTRODUCTION

Emerald ash borer (EAB, *Agilus planipennis*) has killed millions of ash (*Fraxinus* spp.) trees since its accidental introduction from Asia. As it continues to spread, it threatens the very existence of ash in North America. EAB, however, does not devastate its ancient hosts endemic to Asia. Our working hypothesis is that Asian ashes are resistant because they possess targeted defenses to EAB by virtue of their long coevolutionary history. The objective of our research program is to characterize (1) inter- and intra-specific variation in resistance of ash to EAB, (2) underlying mechanisms of resistance, and (3) their genetic basis. Identification of resistance mechanisms and genes will facilitate screening, selection, and/or breeding of ash trees with resistance to EAB.

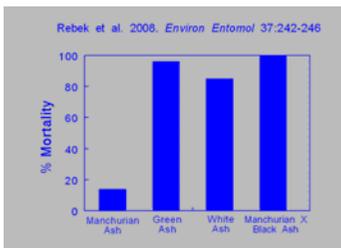


## OBJECTIVES

- 1) Identify resistant germplasm via inter- and intra-specific comparisons in common gardens.
- 2) Identify biochemical mechanisms of resistance focusing on chemical defenses of phloem.
- 3) Identify resistance genes and markers via comparative proteomics and genomics of both hosts and insect.
- 4) Survey for "lingering ash" that continue to survive the EAB invasion in southeast Michigan as a potential source of resistant germplasm.
- 5) Breeding via interspecific hybridization and backcrossing to generate resistant genotypes (J. Koch, USDA Forest Service).

## PROGRESS TO DATE

**Objective 1:** A common garden study at Michigan State University's Tollgate Education Center confirms Manchurian ash (*F. mandshurica*) as a source of resistance genes.

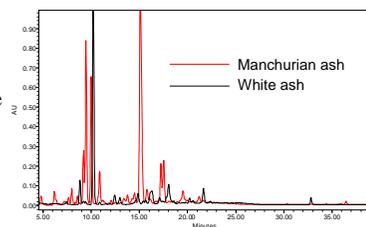


Healthy Manchurian ash surrounded by infested North American ashes

**Objective 2:** Phloem tissue of resistant Manchurian ash was found to contain phenolic compounds not present in susceptible North American species that may be responsible for resistance. Analysis of defensive responses induced by larval feeding is underway.

HPLC comparison of defensive chemistry of ash phloem.

Eyles et al. 2007. *J Chem Ecol* 33:1430-1438



**Objective 3:** Differential gel electrophoresis (DIGE) image of phloem proteomes of Manchurian ash (red spots, resistant to EAB) and black ash (green spots, susceptible to EAB). Yellow spots represent no difference in expression; blue are standards. Proteins expressed in association with resistance traits will be sequenced, followed by identification of underlying resistance genes.



**Objective 4:** "Lingering ash" that continue to survive the EAB invasion at its epicenter in southeast Michigan have been identified in Forest Health Monitoring Plots, and scion wood has been collected to evaluate for EAB resistance.



Lingering ash tree at a site in southeast Michigan where ash mortality is 99%

**Objective 5:** Scientists at the USDA Forest Service Northern Research Station in Delaware, Ohio have begun work to hybridize Asian and North American ash species, with the objective of introgressing EAB resistance genes into North American species. Subsequent backcrossing could then generate an essentially pure North American genotype with EAB resistance genes. A similar approach has been utilized successfully in the program to breed blight-resistant American chestnuts. Identification of resistance markers and genes would greatly accelerate this program.

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