

EVALUATION OF RESISTANCE OF ASIAN AND NORTH AMERICAN ASHES TO EMERALD ASH BORER

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Abstract

Emerald ash borer (*Agrilus planipennis*) is an aggressive killer of ash (*Fraxinus* spp.) in North America, killing even healthy trees. However, limited reports suggest that emerald ash borer does not devastate ash in Asia, but rather that isolated outbreaks occur in response to stresses such as drought. This implies that Asian ashes may be generally resistant, with weakened trees preferentially colonized. Thus, emerald ash borer seems to behave in Asia much as its close native relatives do in North America, including bronze birch borer (*Agrilus anxius*) and two-lined chestnut borer (*A. bilineatus*), which preferentially colonize stressed trees.

Native trees may be more resistant to native pests because of natural defenses that have developed over their long coevolutionary history. Hence, Asian ashes may be a source of resistance genes to emerald ash borer. This hypothesis is supported by a 20-year study of birch resistance to bronze birch borer conducted by David G. Nielsen at the Ohio State University's Ohio Agricultural Research and Development Center in Wooster. Birches native to North America (*Betula papyrifera*, *B. populifolia*, and *B. nigra*) were found to be highly resistant to bronze birch borer (more than 75% of 200 replicate trees of each species survived at least 20 years), while European (*B. pendula* and *B. pubescens*) and Asian species (*B. platyphylla japonica* and *B. maximowicziana*) were extremely susceptible, with every individual (200 replicates of each species) killed in less than 10 years.

To test the hypothesis that Manchurian ash is a source of resistance genes, a replicated ash planting was established in Novi, Michigan in May of 2003 with the following

objectives: (1) compare resistance of native and Asian ashes to emerald ash borer; (2) identify mechanisms of resistance / susceptibility of ashes to emerald ash borer through comparative profiling of constitutive phloem chemistry, as well as induced biochemical responses of phloem to emerald ash borer attack; (3) identify any associated biochemical markers that can be used easily to screen for resistance; and (4) determine the effects of drought and other stress on borer susceptibility. The planting includes white (*Fraxinus americana*) and green ash (*F. pennsylvanica*), Manchurian ash (*F. mandshurica*), with which emerald ash borer shares an evolutionary history in Asia, and Northern Treasure ash (*F. x 'Northern Treasure'*), which is a hybrid between native black ash (*F. nigra*) and Manchurian ash. The inclusion of this hybrid may provide insight into patterns of inheritance of resistance genes, and facilitate their identification. Our major *a priori* hypotheses are (1) Manchurian ash is a source of resistance genes to emerald ash borer; and (2) stress will decrease resistance of Manchurian ash to emerald ash borer, but will have no effect on resistance of North American ashes, which will be highly susceptible regardless of their physiological state.

Identification of resistance mechanisms and their relationship to whole tree physiology will facilitate screening, selection, and/or breeding of resistant trees, as well as identification of silvicultural practices that enhance tree resistance to emerald ash borer. Ash genotypes with resistance to emerald ash borer will be critical to long-term reforestation efforts and preservation of the ash resource in forests, woodlots, and cities.