

COMPARISON OF EMERALD ASH BORER PREFERENCE FOR ASH OF DIFFERENT SPECIES, SUN EXPOSURE, AGE, AND STRESS TREATMENTS IN RELATION TO FOLIAR VOLATILES AND NUTRITION

Therese M. Poland¹, Deepa S. Pureswaran^{2,3}, and Yigen Chen²

¹USDA Forest Service, Northern Research Station, East Lansing, MI 48823

²Michigan State University, Department of Entomology, East Lansing, MI 48824

³Current address: Natural Resources Canada, Canadian Forest Service, Atlantic Forestry Centre, P.O. Box 4000, Fredericton, NB E3B 5P7

ABSTRACT

We investigated the host selection behavior and feeding preference of the emerald ash borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) on six different species of ash including Manchurian ash (*F. mandshurica* Rupr.), green ash (*F. pennsylvanica* Marsh), white ash (*F. americana* L.), black ash (*F. nigra* Marsh), blue ash (*F. quadrangulata* Michx.), and European ash (*F. excelsior* L.). Manchurian ash is native to Asia whereas the other species represent novel hosts for emerald ash borer. We released ~5-day-old beetles into metal screen cages (60 × 60 × 60 cm) containing one leaf from each of the six ash species. Foliage was cut from 2- to 4-year-old greenhouse saplings. Fifteen saplings of each species were used for the study and care was taken to see that leaves from the same plant were not used more than once. Leaves were placed individually in glass vials containing water and arranged in a row across the center of the cage in random order. Thirty beetles were released into each cage, and their distribution on the leaves of the different ash species was observed every 2 hours during the day for 48 hours. Leaves were scanned before and after the experiment to determine the amount of each leaf consumed. This six-choice feeding bioassay was replicated 14 times for each sex. We found beetles landed on and consumed significantly more of the leaves of green, black, and white ash than of blue, European, and Manchurian ash. While beetles fed on leaves from each ash species offered, Manchurian ash and blue ash were least preferred in the six-choice feeding bioassays. When fed on green and Manchurian ash foliage from adult emergence in a no-choice assay, beetles on green ash consumed significantly

more based on leaf area compared to those fed on Manchurian ash. However, neither longevity nor beetle body weight differed in either case, suggesting that Manchurian ash might have greater nutritive value or resistance than green ash.

We then compared the leaf volatiles from intact and girdled (stressed) ash trees for quantitative variation in 12 compounds, which had elicited antennal activity in an earlier study. We found that the overall volatile profiles of the six ash species differed significantly in their relative amounts of these 12 compounds. Green ash had lower relative amounts of volatiles compared to Manchurian ash, which might render it more attractive and less resistant to emerald ash borer. Relative volatile amounts of the other four species were intermediate between levels in green and Manchurian ash.

Finally, we evaluated the performance of emerald ash borer adults fed green ash leaves in relation to nutrition and defensive compounds. The effects of leaf age, sunlight exposure, and tree girdling were compared. Nutrition was quantified by measuring total amino acid content, total soluble protein (P), and nonstructural carbohydrate (C). Defensive compounds measured included trypsin and chymotrypsin inhibitors and total phenolics. We found mature leaves were significantly more nutritious than young leaves, with the highest nutrition in leaves were detected in trees grown in the shade. When compared to young leaves, the mature leaves also had significantly lower levels of both protease inhibitors and total phenolics. Leaves grown

in the sun had reduced amino acids and a lower P:C ratio, irrespective of leaf age and girdling. Sunlight also dramatically increased all defensive compounds of young leaves, but not old leaves. Overall, girdling reduced green ash foliar nutrition but had no effect on the protease inhibitors. Emerald ash borer survival and longevity were greater on mature than on young leaves but did not differ among sunlight treatments, nor between girdled and control treatments. One explanation is that beetles grown on lower quality food compensated by increasing consumption rate. Lower defense of mature leaves alone, or along with higher nutritional quality, may lead to better survivorship and greater longevity of emerald ash borer feeding on mature leaves.