POTENTIAL PRODUCTION OF EMERALD ASH BORER ADULTS: TREE, SITE AND LANDSCAPE-LEVEL APPLICATIONS

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ABSTRACT

Emerald ash borer (*Agrilus planipennis* Fairmaire), an Asian phloem-feeding pest discovered in 2002, is established across southeast Michigan and parts of southern Ontario. More than 35 outlier populations have been identified in other areas of Michigan, Ohio and Indiana. An estimated 12 to 15 million ash (*Fraxinus* sp.) trees in urban and forested areas of southeast Michigan have been killed by emerald ash borer (EAB) and all North American ash are threatened by this exotic pest.

Federal and state regulatory agencies launched major programs in 2002 to contain EAB and to minimize economic and ecological damage likely to occur if this invasive pest continues to spread. To date, containment activities at outlier sites involve felling, removal and destruction of all ash trees within a 200 to 800 m radius of trees known to be infested, to ensure that non-symptomatic but infested trees are removed. Limited funding, however, requires officials to prioritize sites and determine how to allocate limited resources most efficiently while achieving a desired reduction in EAB density. Forest managers and property owners must also compare costs and benefits of alternative silvicultural options for stands with a substantial ash component.

Our objectives were to:

1. Develop a model to predict ash phloem area using tree diameter
2. Determine the number of EAB adults likely to emerge from 1 m^2 of ash phloem
3. Apply models to real-life ash tree inventory data to assess effects of alternative tree removal strategies on potential production of EAB.

We measured surface area, as a surrogate for phloem area, on 148 ash trees ranging from 5.2 to 65.0 cm in diameter at breast height (DBH). After felling, trees were sectioned and length and diameter of sections ≥ 6 cm diam were measured. Surface area measurements from all sections (estimated as a conical frustum) were summed to estimate the area of phloem available to EAB larvae. A second order polynomial model provided the best fit to the relationship between DBH and tree surface area.

Potential production of adult beetles per m^2 of phloem was estimated by counting distinctive EAB exit holes and woodpecker attacks on 71 ash trees recently killed by EAB. Five to 13 areas (depending on tree size) at 1 to 3 m aboveground were intensively examined on each tree; total area examined ranged from 0.17 to 3.73 m^2 per tree. Number of *A. planipennis*

produced per tree ranged from 17 to 170 per m^2 of phloem, but mean and median values consistently hovered around 100 beetles per m^2. Beetle production was roughly 20 percent lower in small trees than in trees that were ≥ 14 cm (4 inches) in diameter. When the smallest trees (< 14 cm DBH) were excluded, an average of 110.3 ± 6.25 beetles developed per m^2 of phloem.

We estimated available phloem and potential EAB production by diameter class for trees at an outlier site in southwest Michigan in the town of St. Joseph. To eradicate this population, regulatory officials delineated an area with a radius slightly greater than 800 m for ash tree removal. Using a 100 x 100 m grid overlaid on the affected area, survey crews measured and marked all ash trees, then tallied the trees by diameter class in each grid cell. Contractors felled, removed and destroyed more than 21,000 ash trees from the site in April 2004. We applied our models to the St. Joseph ash inventory data to estimate potential EAB production by size class at a 200 to 800 m radius around the epicenter of the infestation.

In the treated area (800 m radius), nearly 80 percent of the 21,429 ash trees were small (< 14 cm or 5 inches DBH). Despite their abundance, small trees accounted for less than 10 percent of the total number of EAB that could have been produced in the area. In contrast, trees with commercial value (> 26 cm or 10 inches DBH) comprised only 6.3 percent of the 21,429 trees in the treated area, but would have produced almost 70 percent of the beetles. The St. Joseph site also illustrates the importance of ash tree distribution. Removing ash trees within the first 200 m of the infestation epicenter (an area of 0.13 km^2), a highly urban area, would have reduced EAB production by less than 2 percent. In contrast, many large ash trees in the forested and riparian areas that were 600 to 800 m from the epicenter (still a 0.13 km^2 area) would have produced 58 percent of the beetles.

Results show that effectiveness of EAB containment options, such as removing trees within varying areas or removing only large trees, will be determined by the abundance, size and spatial distribution of ash trees in relation to the source or epicenter of an outlier infestation. More broadly, our models estimate potential EAB production for individual ash trees or for any area of interest where the abundance and size of ash trees is known. This information should help regulatory officials and foresters more accurately evaluate costs and benefits of EAB management options.