BEHAVIORAL ECOLOGY OF HOST SELECTION IN THE ASIAN LONGHORNED BEETLE: IMPLICATIONS FOR SURVEYING, DETECTING, AND MONITORING ADULT BEETLES

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ABSTRACT

The Asian longhorned beetle (ALB) (*Anoplophora glabripennis* Motschulsky) (Coleoptera: Cermabycidae) is among the high-risk invasive species that have invaded the U.S. from China. ALB has attacked approximately 25 deciduous tree species in 13 genera in North America, most notably 7 maple (*Acer*) species. To date, known infestations outside its countries of origin (year found) include New York City and Long Island, NY (1996); Chicago, IL (1998); Braunau, Austria (2001); Jersey City, NJ (2002); Gien, France (2003); Toronto, Canada (2003); Carteret, NJ (2004); Linden, NJ (2006); and Prall's Island, a part of Staten Island (2007). In addition, adult ALB were discovered in Sacramento, CA (June 2005), putting at risk many tree species in the western U.S. Infested trees continue to be found in the New York and New Jersey infestations, with 69 and 89 infested trees discovered, respectively, in the New York, and the Carteret and Linden, NJ, infestations in 2006. During 2007, a total of 80 infested trees were discovered and removed in the New York infestation as of April 22 (15 in Queens, 21 in Brooklyn, 41 on Prall's Island, and 3 on Staten Island). The total number of infested and high-risk trees removed from the North American infestations, as of April 22, 2007, includes 10,989 trees (6,184 infested) in New York City; 1,771 trees (1,551 infested) in Chicago, IL; 461 trees (113 infested) in Jersey City, NJ; 25,000 trees (600 infested) in Toronto, Canada; and 21,513 trees (616 infested) in Carteret and Linden, NJ. It should be noted that the infestation on Prall's Island is being eradicated via removal of all host trees, totaling 2,933 high-risk trees and 41 infested trees removed as of April 22.

Survey for trees infested by *A. glabripennis* depends solely on the visual inspection of individual trees by surveyors within a specified radius from trees showing signs or symptoms of attack. These visual surveys focus specifically on tree species reported to be hosts of ALB. However, the USDA Animal and Plant Health Inspection Service (APHIS) reports visual surveys to be 33-60% effective, depending upon the survey method used (i.e., ground survey, bucket truck survey, tree climber survey). Furthermore, visual surveys are very expensive, thereby limiting the number of trees inspected. To date, no methods are used specifically to detect and monitor adult *A. glabripennis* in the existing infestations in New York, New Jersey, and Chicago, such as sentinel trees or attractants. Therefore, the objectives of the research reported here were to develop (1) sentinel trees for detecting of adult ALB, (2) an attract-and-kill strategy for monitoring adult ALB, and (3) an artificial lure for detecting and monitoring adult ALB.

Sentinel Trees Studies

The objectives of the sentinel tree studies were to evaluate (1) the relative attractancy of ALB to five key tree genera used by ALB as hosts in China (*Tilia*, *Eleagnus*, *Salix*, *Populus*, and *Acer*); (2) the effects of wounding on the attractancy of ALB to *Acer mono* and *Acer negundo*; (3) the relative attractancy of ALB to *Acer mono*, *Acer platanoides,* and *Acer truncatum*; and (4) the efficacy of *Acer mono* to attract ALB from ALB-infested *Acer negundo* landscape trees and under varying ALB population levels.

Results from replicated field studies showed, to date, the following. (1) *A. glabripennis* is significantly more attracted to *A. mono* than to *Tilia paucicospapa*, *Eleagnus agustifolia*, *Salix babylonica*, and *Acer negundo.* Although the sex ratio of the background population was approximately 1:1 (F:M), female *A. glabripennis* were significantly more attracted than male *A. glabripennis* to *A. mono* at an approximate ratio of 3.5:1 (F:M). (2) *A. glabripennis* is significantly more attracted to *A. mono* than to *Acer platanoides*, the key maple species attacked in the U.S., and to *Acer truncatum*, a sister species of *A. mono* in China. (3) Wounding of *A. mono*, either produced by adult female *A. glabripennis* feeding on twigs, petioles, and leaves or by artificially simulated adult beetle feeding on twigs, significantly increased *A. glabripennis* attraction, particularly of adult female *A. glabripennis*. Although the sex ratio of the background population was approximately 1:1 (F:M), female *A. glabripennis* were significantly more attracted than male *A. glabripennis* to the wounded *A. mono* at an approximate ratio of 2:1 (F:M). Collectively, these results indicate that *A. glabripennis*, particularly female beetles, are attracted to the host odors of *A. mono*. Studies also showed that *A. glabripennis* attraction to *A. mono* occurs during both peak and declining ALB population levels and that *A. mono* is capable of attracting adult beetles out of large *A. negundo* landscape trees. These results provide the basis for using *A. mono* for detection and monitoring of adult *A. glabripennis*.

Attract-and-Kill Studies

Studies were conducted to determine if potted *A. mono* trees treated with Scimitar® (an encapsulate pyrethroid) altered the attractancy of ALB to *A. mono*. Results from studies initiated in 2006 showed that ALB attraction, particularly of female ALB, was not altered by treating potted *A. mono* with Scimitar® at either 300 mg a.i. /L or 450 mg a.i. /L. Although studies will continue in 2007, these results provide the preliminary basis for using *A. mono* for monitoring adult ALB.

Artificial Lure Studies

Artificial lure studies were conducted (1) to isolate and identify the volatiles emitted by *A. mono* that are electroante-nnographically active, and (2) to identify blend(s) of *A. mono* host volatiles that are attractive to *A. glabripennis* in an olfactometer bioassay. Results from GC-EAD studies have identified a group of antennally active *A. mono* host volatiles. Additionally, results from olfactometer studies have thus far identified blend(s) of host volatiles that are significantly attractive to adult female *A. glabripennis*. Olfactometer studies are continuing and field studies will be conducted in 2007.