
MICROBIAL CONTROL OF THE EMERALD ASH BORER

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ABSTRACT

In June 2002, emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, a buprestid native to several Asian countries, was identified as the causative agent of ash (*Fraxinus* spp.) mortality in southeastern Michigan and southwestern Ontario. Currently, the only method known to control EAB is limited to identifying and destroying infested trees. Conventional insecticides, when identified, will be broadly toxic, expensive, and may require handling by licensed applicators, making their widespread use in parks, woodlots, forests, wetlands, and riparian areas unlikely. Public acceptance remains high for microbial insecticides formulated with *Bacillus thuringiensis* (Bt) and *Beauveria bassiana* due to good safety records and compatibility with other management strategies, including biocontrol.

We screened EAB adults with four registered Bt-based microbial insecticides formulated with different Bt strains. Using a spray tower, we applied Bt at 20 gal/acre and found some products were toxic to EAB adults in the laboratory, but at relatively high concentrations. We are identifying the EAB-active toxins produced by Bt, and will evaluate if Bt products can be developed for use in EAB management using aerial application technologies.

BotaniGard[®] is a microbial insecticide made from the insect pathogenic fungus *Beauveria bassiana* var. GHA and was registered for control of insects pests of forest and shade trees in 1999. We are developing EAB control methods using BotaniGard[®] for use by homeowners and managers of municipalities, parks, and other in environmentally sensitive areas such as forests, woodlots, and wetlands. In summary:

1. Using laboratory bioassays, we determined that adults were more susceptible than larvae to *B. bassiana* GHA. Additional laboratory studies involved comparisons of two BotaniGard[®] formulations: BotaniGard ES[®] is formulated with petroleum-based oils; BotaniGard O[®] is formulated with vegetable oils, for use by growers of organic food. In subsequent the laboratory bioassays, we exposed EAB adults for 24 hrs to ash leaves sprayed with serial dilutions of BotaniGard ES[®] and BotaniGard O[®] with a spray tower at the rate of 20 gal/acre. EAB were cultured for *B. bassiana* infection after death. The LC₅₀ of the BotaniGard[®] formulations were similar, and averaged 4.9 and 4.7 spores/cm² for BotaniGard ES[®] and BotaniGard O[®], respectively; these values demonstrate similar virulence of these two formulations and high virulence *B. bassiana* GHA against EAB. The LT₅₀s for BotaniGard ranged from 4 to 10 days, depending on spore concentration.

2. In the greenhouse, we compared the efficacy of BotaniGard ES® against adults when sprayed on leaves vs. logs; 2 qts BotaniGard®/acre was applied with a spray tower to:
 - a) foliage of potted ash trees caged with adults;
 - b) uninfested ash logs caged with adults; and
 - c) caged pre-emergent infested ash logs.

After death, beetles were cultured for fungal infection; we determined that 10 percent of adults caged with sprayed trees, 18 percent of adults caged with sprayed logs, and 61 percent of adults emerging from sprayed logs were infected with *B. bassiana*; no controls were infected.

3. In the field, we sprayed EAB-infested tree trunks prior to beetle emergence (spring 2003), with 2 and 20 qts BotaniGard®/acre in a hand-held sprayer; treated and control tree trunks with epicormic shoots were then caged, and EAB were allowed to complete their life cycle within the cage. After death, EAB were cultured for fungal infection; at 0, 2, and 20 qts/acre, prevalence of *B. bassiana* infection among adults was 0 percent, 43 percent, and 76 percent, respectively. At present, we are dissecting these ash trees to determine if pre-emergent BotaniGard-trunk treatments resulted in lower EAB infestation due to larval infections.
4. In the field, we sprayed EAB-infested ash trees (fall 2003) with 14 qts BotaniGard®/acre using a hand-held sprayer. Although there were no emergence holes on these trees, bark cracks suggested the presence of EAB larvae under the bark. We are currently dissecting the trees to determine if BotaniGard® infects larvae under tree bark via bark cracks. Although less than half of the trees have been dissected to date, we have found 10-20 percent of EAB larvae infected with *B. bassiana* in the sprayed trees vs. 0 percent in unsprayed control trees. Based on the results of this study, we recommend earlier BotaniGard® trunk sprays as many of the EAB larvae had begun to enter the sapwood for overwintering.

In 2004, we plan to expand these and other studies of BotaniGard to include additives such as surfactants and UV protectants; larger field trials are planned. In conclusion, the results of our studies demonstrate that BotaniGard® shows promise for control of EAB.