

Control of Emerald Ash Borer with Microbial Insecticides

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Overview:

Currently, the only proven method to control emerald ash borer (EAB) is by identifying and destroying infested ash trees. Conventional insecticides may be broadly toxic and require handling by licensed applicators, making their widespread use in parks, woodlots, forests, wetlands, and riparian areas unlikely. We are studying the efficacy of registered microbial insecticides for EAB control in environmentally sensitive habitats. Microbial insecticides are made from microscopic living organisms capable of killing specific insects under certain conditions, and are generally considered safe and acceptable to the public because they are 1) non-toxic to humans, wildlife, birds, fish, and other organisms except specific insects; 2) found naturally in the environment; 3) biodegradable; 4) compatible with other control methods including biological control.

***Bacillus thuringiensis* (Bt) results:**

Various isolates of Bt, a bacterial pathogen of insects, are the active ingredients of registered insecticides used to control different insect pests. For more than 30 years, aerial application of Bt has been used throughout the world for control of forest insect pests. We studied the activity of four registered Bt-based insecticides against EAB adults. In the laboratory, Bt was applied to ash leaves at 20 gal/acre using a spray tower. EAB adults were allowed to feed on the sprayed leaves for 7-10 days and dead EAB were removed daily. Although consuming Bt resulted in death of EAB adults in 2-5 days, the concentration of each product exceeded the maximum-labeled rate. According to the manufacturer, a label change for use of these Bt-insecticides against EAB is unlikely. We are now studying the response of EAB adults to other Bt isolates and toxins for possible development of new Bt-insecticides for control of EAB in aerial spray programs.

***Beauveria bassiana* var. GHA results:**

Beauveria bassiana var. GHA, a fungal pathogen of insects, is the active ingredient of BotaniGard[®], a microbial insecticide registered for control of insect pests of forest and shade trees in 1999. In 2002-2003, we discovered that fungi are important natural enemies of EAB, and began to study the only registered fungal insecticide for possible use in controlling EAB. In summary:

(1) In the laboratory, we determined EAB adults were more susceptible than larvae to *B. bassiana* GHA. Additional laboratory studies involved comparisons of two BotaniGard formulations: BotaniGard ES, formulated with petroleum-based oils, and BotaniGard O

formulated with vegetable oils. In subsequent 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. We found that BotaniGard was highly virulent against EAB adults, causing death within 3-5 days depending on spore concentration. The two BotaniGard formulations were equally virulent against EAB, requiring about 5 spores/cm² to kill 50% of those exposed.

(2) In the greenhouse, we compared the efficacy of BotaniGard ES against adults when sprayed on leaves vs. logs at 2 qts BotaniGard/100 gal (1.25 tablespoons/ gallon) was applied with a spray tower to: (a) foliage of potted ash trees caged with adults; (b) uninfested ash logs caged with adults; (c) caged pre-emergent infested ash logs. After death, beetles were cultured for fungal infection; we determined that 10% of adults caged with sprayed trees, 18% of adults caged with sprayed logs, and 61% 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/100 gal with 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; 0%, 43%, or 76% EAB died from fungal infection at 0, 2, or 20 qts/100 gal, respectively. The maximum-labeled rate for BotaniGard is 17 qts/100 gal. 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 (October 2003) with 14 qts BotaniGard/100 gal 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 10-30% of EAB larvae infected with *B. bassiana* in the sprayed trees vs. 0% in unsprayed control trees. Because many of the EAB larvae had entered the sapwood to overwinter in October when we sprayed, we would recommend earlier fall trunk sprays, when larvae are still under the bark. In 2004, we plan to expand these and other studies of BotaniGard to include additives such as surfactants to increase bark penetration and UV protectants; larger field trials are also planned. In conclusion, the results of our studies demonstrate that BotaniGard shows promise for control of EAB.