UPDATE ON THE EFFICACY OF SELECTED SYSTEMIC INSECTICIDES FOR THE CONTROL OF THE ASIAN LONGHORNED BEETLE

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Abstract

This is an update of the study we have been doing in China to evaluate insecticides and delivery techniques for the control of the Asian longhorned beetle (ALB), *Anoplophora glabrispennis*. The following people and institutions have also contributed or participated in the study: Phillip A. Lewis, David R. Lance, and David M. Cowan from USDA APHIS CPHST, Otis Laboratory, and Baiying (city) and Jingtai (county) Forest Protection Station, Gansu Province, China.

Our studies prior to 2003 involved cover insecticides and systemic insecticides. Different cover insecticides were tested for efficacy and persistency at different doses. Various systemic insecticides were tested for their efficacy for ALB control at different doses, application times and delivery methods. Several cover insecticides were tested in two different years with different application methods. In one test, the twigs of poplar trees were dipped into insecticide solutions and then provided to ALB adults, while in another test; twigs were collected from treated poplar trees and then provided to ALB adults. In both cases, generally, the tested insecticides showed good short term efficacy, but poor long term efficacy. Among the tested systemic insecticides (i.e., methamidophos, disyston, acephate and metasystox-r, imidacloprid, acetamiprid, thiamethoxam, and thiacloprid), imidacloprid and possibly thiamethoxam and acetamiprid can be used effectively to kill adult ALB beetles through soil and tree trunk injection. Significant mortality of adult beetles was observed 2 years after application with imidacloprid treatments. Mortality of ALB larvae, especially, late instars, however, was low. Residue levels of imidacloprid in treated trees and efficacy were limited by a number of factors such as delivery method, timing of application, tree species, and tree size. To establish the response of adult beetles to doses of imidacloprid, we also conducted two tests. In one test, twigs of silver maple were dipped in different concentrations of imidacloprid solutions. While in another test, twigs were freshly cut from treated host trees. In both cases, these twigs were provided to caged adults and the beetles were checked regularly for their mortality. The levels of imidacloprid in twigs were determined through chemical analysis. The LC_{50} of imidacloprid for adult ALB is 1.9 ppm for a 3-day exposure.

In 2003, to minimize the time that takes to inject and guard injected trees when imidacloprid is applied with the standard Mauget micro injection technique, and to compare officacy of imidacloprid with other neo-nictinyl systemic insecticides, we evaluated dinotefuran and thiamethoxam, and imidacloprid through different delivery methods for their efficacy for ALB and the standard Mauget Imicide. The three insecticides were compared using the delivery methods (checked) listed in Table 1.

Mortality was checked for ALB adults caged with treated trees, and for wild beetles that migrated to and fed freely on treated trees. Five to 10 trees in each treatment group were dissected in October of the same year to check status of different stages such as egg, larva, pupa, and adult. The number of egg sites and exit holes were recorded.

Mortality of adult beetles caged with treated trees was greater than the control for all treatments, except for soil injected and trunk implanted dinotefuran, and soil injected thiamethoxam. A possible reason for their lower adult mortality in treatments of tree implant and soil injection might be that beetles were caged soon after insecticide application. We know that translocation of imidacloprid is faster where trees are trunk injected versus trunk implanting and soil injecting. Speed of uptake

Table 1.—Delivery methods for the three neonictinyl insecticides in the 2003 study

Delivery Method (Treatment Name)	imidacloprid	dinotefuran	thiamethoxam
Imicide by J. J. Mauget Co. (Imicide)	x		
SW100 Injector Gun by ArborSystems, Modified & with USDA Tip (Modified Wedgle)	x	x	
Manually Operated Device by ArborJet, Inc., Tip replaced with USDA Tip (Modified Arborjet Device)	x	x	
Soil Injection, Kioritz (Soil Injection)		x	x
Tree (Trunk) Implants by Creative Sales (Trunk Implant)		x	

might also be similar for dinotefuran and thiamethoxam using these techniques. The number of dead beetles found on the ground under the canopy of treated trees was higher than the control except for dinotefuran when it was trunk implanted. The highest mortality was found in the treatment using the Modified Wedgle, which was not statistically different from several other treatments, such as Imicide, as well as imidacloprid and dinotefuran applied through Modified Arborjet. Treated trees were dissected in October to assess the efficacy of different treatments. All stages of beetles, whether dead or alive, were recorded. In terms of the combined mortality of different stages of the beetle found inside of the tree, Mauget Imicide treatment was significantly greater than others. Dinotefuran applied using Trunk Implant and the control was among the lowest.

Samples were collected from treated trees to determine the level of insecticide in treated trees using different delivery methods, but chemical analysis has not completed and additional samples will be collected.

To establish a dose-response curve for ALB to dinotefuran and thiamethoxam, caged beetles were provided with fresh twigs cut from trees treated with these insecticides. Beetles were checked for mortality and consumption of the bark of twigs at least 7 days starting 24 hours after the introduction of adults. Levels of insecticides in twigs were determined through chemical analyses using HPLC, and LC50 was determined through regression using the SAS Probit procedure. Generally, mortality increased as the level of dinotefuran and thiamethoxam increased, but mortality increase leveled off after mortality reached around 80%. The 3-day LC_{50} value for dinotefuran was close to that for imidacloprid, but higher than that for thiamethoxam. But the 3-day LC_{90} values for dinotefuran and for thiamethoxam were both much higher than that for imidacloprid.