February 5, 2007

Mr. Brian Hughes
Michigan Dept. of Agriculture, PPPM Division
P.O. Box 30017
Lansing, MI 48909

Dear Brian,

This letter is in support of the application by Valent USA Corp. for a Section 24(c) registration for dinotefuron (Safari™) applied as a non-invasive, low pressure bark spray for control of emerald ash borer (*Agrilus planipennis* Fairmaire). As you know, emerald ash borer (EAB) is an invasive phloem-feeding pest native to Asia that was discovered in North America in 2002. Adult beetles feed on ash foliage from May through August. Larvae feed in phloem on the branches and trunk of ash trees during late summer and fall, disrupting the ability of the tree to transport nutrients and water (Cappaert et al. 2005). An estimated 20 million ash trees have been already been killed by EAB in southeast Michigan alone. This invasive pest threatens more than 800 million ash trees in Michigan forests. Millions of landscape ash trees planted by communities and private landowners will need to be removed or treated with insecticides annually. A recent economic analysis predicted that EAB impacts on landscape trees would cost Ohio communities $1.8 to $7.6 billion (Sydnor et al. 2007).

Background: Neo-nicotinoid insecticides, including dinotefuron and imidacloprid, are the most widely used products in lower Michigan to protect ash (*Fraxinus* sp) shade trees from emerald ash borer (EAB). These products are relatively safe for humans and have few non-target effects. Trees are generally treated annually by injecting the insecticide into the soil for uptake by roots or by directly injecting the product into xylem cells at the base of the trunk. Following uptake or trunk injection, the insecticide is translocated to the canopy and into the foliage, where it affects adult EAB beetles during the summer.

Questions and concerns have arisen about the long-term effects of repeated wounding associated with annual trunk injections for EAB control. In addition, trunk injection equipment can be expensive and typically requires special training for applicators. Some systems can require applicators to remain on-site to monitor uptake of the insecticide. Potential movement of soil-injected products into soil or ground water may restrict use of these products in some sites.

Non-invasive trunk spray: In 2006, we evaluated a non-invasive, efficient and simple method of applying dinotefuron to the trunk of ash shade trees. This application method involves mixing the insecticide with a registered, non-toxic, bark-penetrating surfactant (Pentra Bark®, Agrichem, Medina, OH). The formulated solution is applied at low pressure with a common garden sprayer directly to the bark on the lower trunk of a tree, from roughly 20 cm to 1.6 m above ground. The bark is sprayed until wet but not dripping.

We hypothesized that this application method would enable the dinotefuron, which is highly soluble in water, to be carried through the bark to the xylem tissue, then translocated to the foliage.

Study design: We conducted a relatively extensive study in 2006 to assess whether this application method would effectively translocate the dinotefuron insecticide to the tree canopy and protect treated trees from heavy EAB damage. We established a randomized complete block design that was replicated at three sites to ensure that we evaluated a range of tree size and bark thickness. Mean diameter at breast height (DBH) of trees used in the study ranged from 5.0 inches at the site with the smallest trees to 15.5 inches at the site with the largest trees. There were 6 to 12 trees per treatment at each of the four sites. Each block consisted of trees treated with a non-invasive trunk spray of (1) imidacloprid + Pentra; (2) dinotefuron + Pentra; (3) a soil application of imidacloprid applied at the base of the tree with a Davey wand; (4) a trunk injection of imidacloprid applied with Mauget capsules (e.g., a positive control) or (5) left as an untreated control (Table 1). Insecticides were applied in late May. Residue, bioassay and larval density data (see below) were analyzed with analysis-of-variance or the nonparametric equivalents and multiple comparison tests (when ANOVA results were significant) to assess effects of treatment and site ($P<0.05$).

Evaluation and Results: We quantified dinotefuron residues in leaves collected from each tree in mid June, early July, late July and mid August using MS/HPLC, in cooperation with the USDA APHIS laboratory in Gulfport, MS. Dinotefuron levels in foliage peaked in mid June at all three sites (Fig. 1), roughly 3 weeks after sprays were applied. Average mid June concentrations exceeded 2.0 ppm at two sites with large trees and exceeded 5.0 ppm at the site with the smallest trees. Dinotefuron residues dropped relatively quickly to roughly 1.0 to 2.0 ppm by early July (Fig. 1).

We also conducted 4-d bioassays in mid June, early July and late July to assess survival of EAB adults caged with leaves from each study tree. On each date, two leaves were collected from opposite sides of each tree and three beetles were placed on each leaf for four days. In all three bioassays, EAB survival on leaves from trees treated with the dinotefuron+PentraBark spray was significantly lower than EAB survival on untreated control trees (Fig. 2). We noted that mid June leaf residues exceeded 2.0 ppm in 13 trees treated with the dinotefuron + PentraBark spray. On 12 of those 13 trees, no EAB survived to Day 4 in the mid June bioassay (Fig. 3).

Larval density was quantified in fall by excavating bark windows (> 500 cm^2 each) excavated on the trunk and 4 to 6 locations in the canopy of treated and control trees. At the 7L-L site with moderate EAB density, trees treated with the dinotefuron + PentraBark trunk spray had significantly fewer larvae per m^2 than untreated control trees (Fig. 4). On average, trees treated with the dinotefuron + Pentra trunk spray had 75% fewer larvae than untreated control trees. Larval density did not significantly differ between trees treated with dinotefuron + PentraBark and trees treated with the conventional Mauget capsules, which reduced larval survival by 81%. Differences in larval density at the other sites were obscured by high within-treatment variability or unexpectedly low EAB density.

Summary: Our results indicate that the noninvasive trunk spray with dinotefuron + Pentra Bark was at least as effective as the conventional trunk or soil injection application methods for EAB control. There are several advantages, however, associated with the noninvasive trunk spray application method. This application method is efficient, requires only an inexpensive garden sprayer and could substantially reduce costs associated with EAB control on landscape trees. Like other systemic application methods, the noninvasive trunk spray has minimal effects on non-target organisms. Furthermore, the noninvasive trunk spray does not create any wounds on the tree and there are no soil contamination problems.

I believe the results of our 2006 studies, the costs and concerns associated with conventional application methods for systemic insecticides, and the potentially staggering impacts of EAB on urban ash trees, justify approval of a 24(c) registration for the Safari Insecticide+PentraBark trunk spray. If I can be of further assistance or provide more information, please let me know.

Sincerely,

Deborah G. McCullough
Professor

References

Cappaert, D., D.G. McCullough, T.M. Poland and N.W. Siegert. 2005. Emerald ash borer in North America: a research and regulatory challenge. American Entomologist 51(3):152-165.

Syndor, T.D., M. Bumgardner and A. Todd. 2007. Potential economic impacts of emerald ash borer (*Agrilus planipennis*) on Ohio, U.S., communities. Arboriculture and Urban Forestry 33:48-54.

Table 1. Application rates and dates for imidacloprid (Imi) and dinotefuron (Dino) treatments applied to ash trees in 2006.

	Untreated controls	**Imi -trunk injection (positive control)**	**Imi - Soil application**	**Imi + Pentra trunk spray**	**Dino + Pentra trunk spray**
Application method	---	Mauget capsules (3 ml)	Davey wand at base of tree	Garden sprayer; 3.2 fl oz/inch DBH	Garden sprayer; 3.2 fl oz /inch DBH
Product	---	10% Imicide;	Macho 2F (21.4%)	Macho 2F (21.4%) + 3 oz. Pentra/gal	Safari (20%) + 3 oz. Pentra/gal
AI per inch DBH	---	0.15 g	1.42 g	1.70 g	1.70 g
Application date	---	May 29	May 22	May 22	May 22

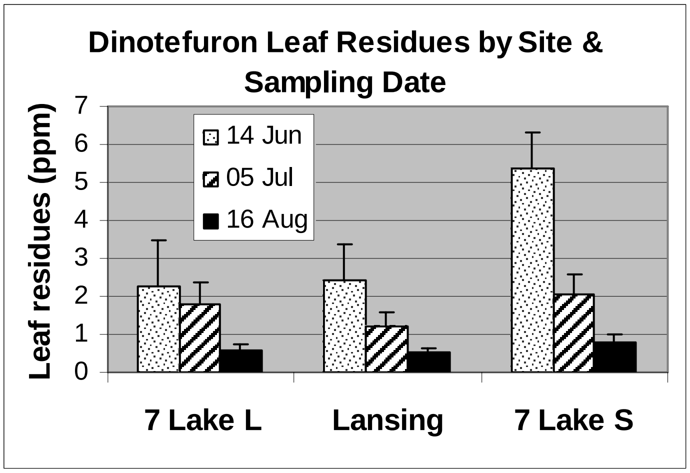

Fig. 1. Foliar dinotefuron residue levels in leaves collected from trees treated with the noninvasive dino+PentraBark spray at three sites.

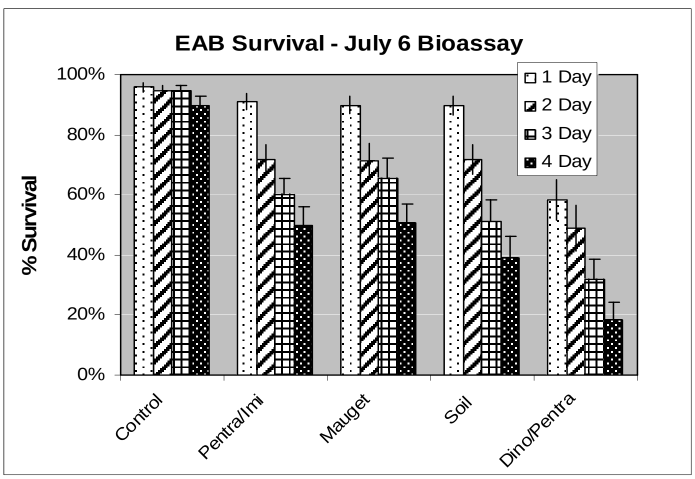

Fig. 2. Percent survival of EAB by day during July 6 bioassay. Note that average Day 4 survival of EAB on leaves from Dino/Pentra trees was less than 20%.

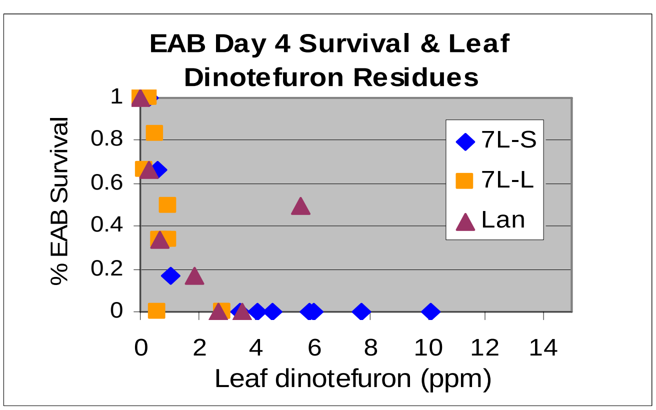

Fig. 3. In mid June, when foliar dinotefuron residues were ≥ 2ppm, 100% of the EAB beetles died by Day 4 of the bioassay on all but one tree.

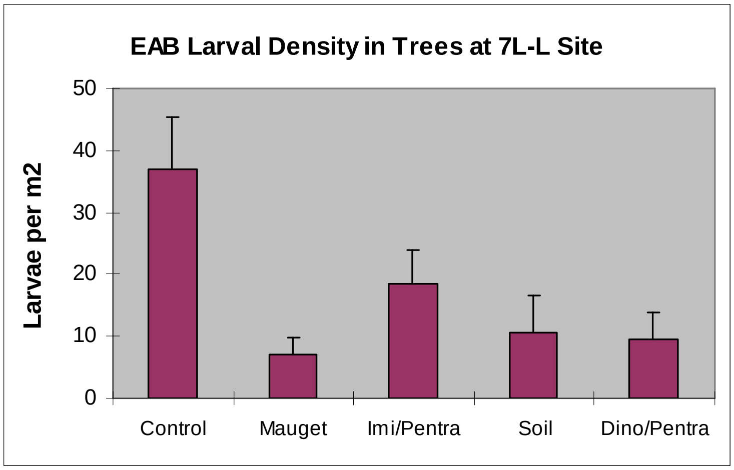

Fig. 4. Larval density in fall 2006 by treatment at the 7L-L site. All treatments except the Imi/Pentra spray differed significantly from controls. Differences among treatments were not significant.