

Insights from Applying Systemic Pesticide to Trees for APHIS Eradication Programs

USDA-APHIS-PPQ

Insecticide and Applied Technologies Section

Pest Detection and Exclusion Laboratory

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Asian Longhorned Beetle

- Established populations being eradicated in NY, Chicago, NJ and Toronto
- Discovered in Brooklyn, NY in 1996
- Treatments include soil (90+ %) and trunk injections with imidacloprid



Components of Basal Soil Injection Apparatus (or you can use a big truck to supply the mix and use the injection wand)



Trees are treated with $\frac{1}{2}$ to 1 cup of mix per inch of tree DBH @ max labeled rate (2 or 4 packets of Merit 75 WSP per 3 gallons. Apply near base of tree.

Trunk Injection



Mauget Imicide Capsules



Arborjet's
VIPER
Injector with
Stinger tips



- Mauget capsules utilized in woodlots
- VIPER gun used in difficult access areas, near standing water, etc.
- VIPER gun can deliver 4 formulations of imidacloprid (Imajet 5%, Arborjet; Pointer 5%, Arborsystems; Imicide 10%, JJ Mauget; Merit TI, 17%, Bayer) Rate per inch tree DBH is 4 mL for 5%, 2 mL for 10%, 1 mL for 17%

Emerald Ash Borer



Currently no official program treatments for chemical control; imidacloprid has shown positive impact on even large trees treated annually (soil) before infestation signs appear. Emamectin (Tree-age, Arborjet) looks good, but limited info so far.



Direct Trunk Injection Studies

Objective:

To develop an effective replacement for the Mauget capsule technology & for situations where soil injection is not possible or practical

- minimize injury
- immediate delivery

Trunk injection systems tested



Mauget's Quick Inject System



Sidewinder

USDA Injector



Arborjet's VIPER injector



Arborsystem's Wedgle



Additional injection systems tested

Trunk Injection Devices and Formulations Approved for use in the Asian Longhorned Beetle Eradication Program

Injection Device / System	Company	Year Tested	Pass / Fail
Mauget Micro-Injection System	JJ Mauget Co.	1997	PASS
Arborjet VIPER with Stinger Tips	ArborJet, Inc.	2003 & 2004	PASS
Arborjet Hand-held Injection System	ArborJet, Inc.	2004	FAIL
BioJect System	BioForest Technologies, Inc	2004	FAIL
ChemJet Tree Injectors	Chemjet Trading, Pty. Ltd.	2004	FAIL
Davey Beetle Buster Tree Injector	Davey Tree Expert Co.	2004	FAIL
Bayer Tree Injector	Bayer CropScience	2004	FAIL
Sidewinder Tree Injector	Sidewinder, Pty. Ltd.	2004	FAIL
Davey Beetle Buster Tree Injector	Davey Tree Expert Co.	2005	PASS
EcoJect System	BioForest Technologies, Inc	2005	FAIL
Bartlett Tree Injector	Barlett Tree Research Lab	2005	FAIL
Mauget Liquid Loadable System	JJ Mauget Co.	2006	FAIL
M3 caps (revised Barlett system)	Rainbow Treecare Scientific	2007	FAIL
EcoJect System	BioForest Technologies, Inc	2007	PASS
Tree Tech microinjection systems	Tree Tech, Inc	2008	ongoing

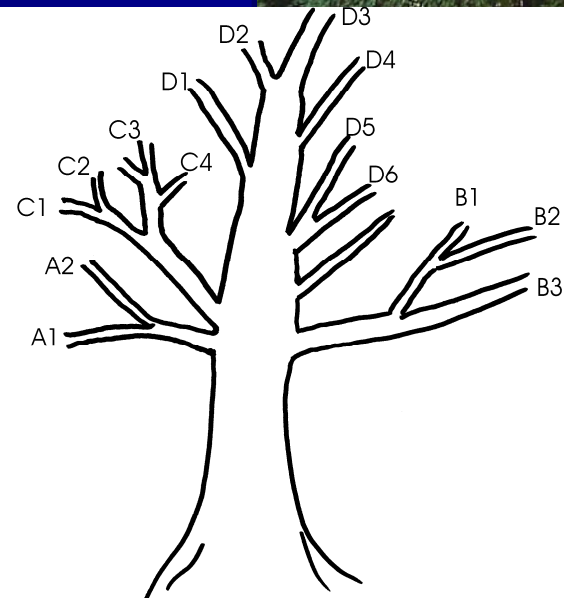
If you want additional info on why the system failed testing, let me know. I've also looked at Arborjet's Tree IV system, but this is too slow and requires mixing at each tree, not feasible for the ALB program. It is possible this system will result in better distribution of chemical than other trunk systems.

Injection Summary

- Arborjet device best matched Mauget standard for residue levels and minimal damage to tree
- USDA tip (= Stinger tip as sold by Arborjet) was least intrusive based on damage assessment results

Imidacloprid Distribution within Trees Treated by Direct Trunk Injections

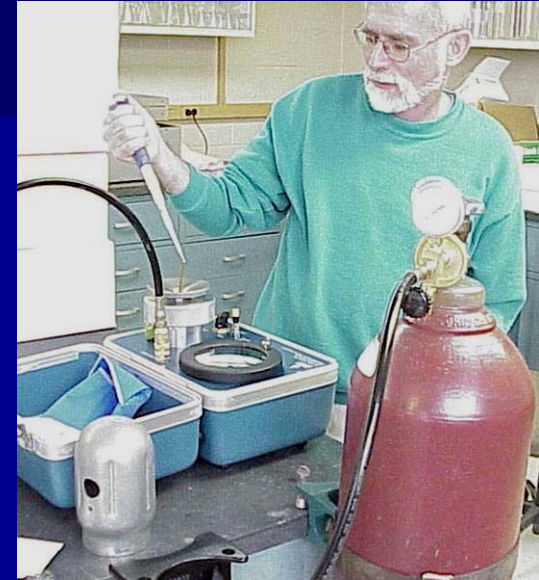
Test Trees



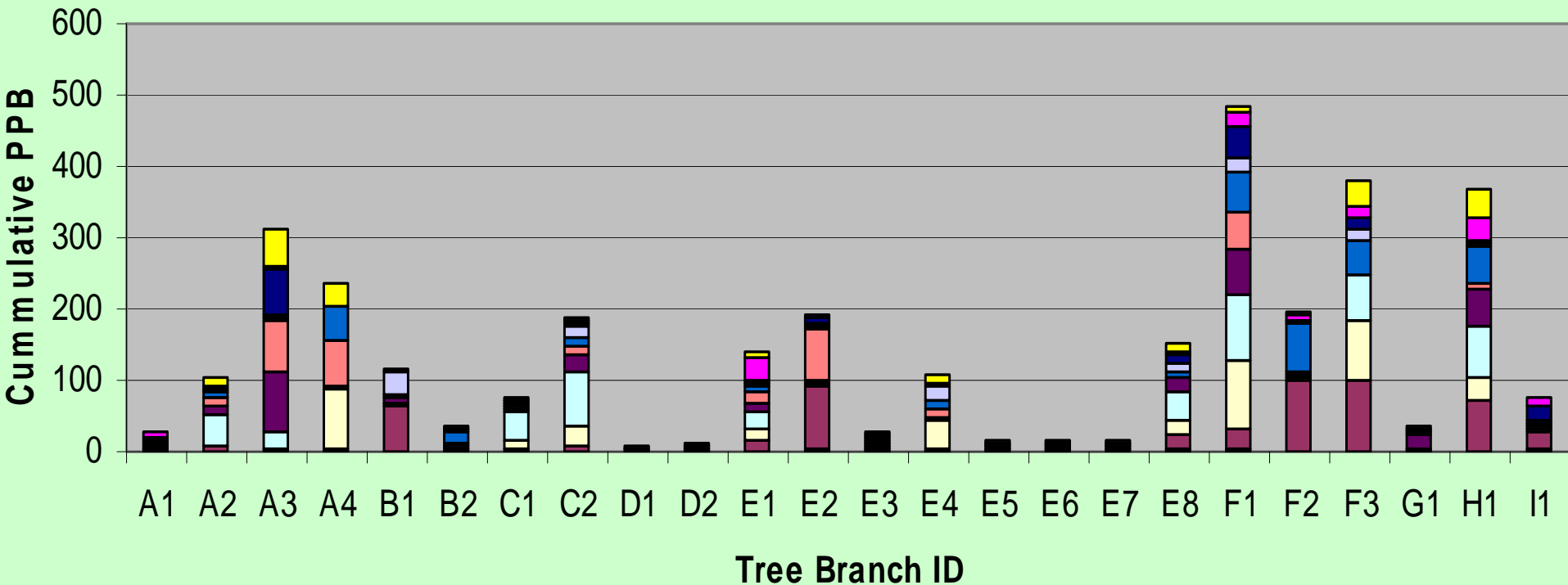
Detecting Pesticide Residue in Treated Trees

ELISA Assay

- Sensitive (ppb)
- Inexpensive (~\$10/sample)
- Rapid
- Available from EnviroLogix.com



Mauget Trunk Injection



- residue was detected in 71% of the samples,
- sustained levels of residue in 38%
- variable levels in 25% of the samples

Distribution Summary

- Samples were collected from throughout the trees at weekly intervals for 3 months
- Within a tree, distribution of imidacloprid can be quite variable.
- Imidacloprid residue levels varied between and within a branch group, and over time.
- Subsequent testing found that using tree sap as residue indicator is faulty; we now use composite leaf samples to compare residue, also see next slide...

Considerations when Determining Imidacloprid Residue

Xylem sap is not a good indicator of tree residue

- xylem sap values are quite variable and low (ppb range)
- ALB targets leaves & twigs for feeding; twigs contain less residue than leaf material (~6x less, dry weight basis)

ELISA assay is an inexpensive, accurate method for residue determination in plant tissues

- HPLC analysis costly, requires extensive sample clean up (loss of a.i. of up to ½) and variable reproducibility

Soil injection is cheaper than Trunk treatments

- soil treatments are rapid and cost far less due to labor and cost of product (approx. 4x more for trunk / DBH inch)

Trunk injection yields higher residue than soil treatments

- residue values for soil applications after 3 months average ~ 15 ppm @ max labeled rate of 0.56 g/cm & 50 to 200 ppm by trunk injection @ 0.16 g/cm

Damage Assessments



Damage Summary

- **Damage increased between 9 mo. and 1 year observations**
- **During injections the Wedgle method was observed to result in bark splitting and separation (see pictures)**
- **Obvious vertical cracks were evident in trees injected with the Mauget Quik-Inject, Sidewinder and Arborjet systems (when using their plugs, not the stinger tips)**
- **Weeping around the injection site was seen with Mauget injections**
- **Based on field experience, use of the USDA tip was least intrusive and most consistent with the standard Mauget method in terms of residue levels and damage.**

Damage due to Arborjet injections using plugs



Wedge plug

Damage due to Wedgle injections



Additional Studies

- Injection timing, longevity
 - Soil injections (spring vs fall). Study is ongoing, results expected at the end of '08
 - Trunk injections (1x, 2x rates). 2x rate of imidacloprid does not yield multi-year control
- Soil injection of restricted street trees (sidewalks, narrow parkways, etc.). This study found that application directed at the base of the tree is ideal, either by drench or using the BSI method

Other systemic products

- See Wang et al., JEE 98:2292-2300, 2005 for a list of systemics for ALB control (tested LC50's for imidacloprid, clothianidin, dinotefuran, thiamethoxam)
- See following pages for other potential materials and their limitations...

Alternative a.i.'s

- Thiamethoxam – Syngenta
 - Flagship (nursery), Actara (pome fruits)
 - Foliar application, Soil not on label
- Emamectin benzoate – Syngenta
 - Limited efficacy data from EAB, but looks good (99+% control of larvae, MSU data)
- Clothianidin – Arvesta/Arysta
 - Celero 16 WSG (ornamentals)
 - Foliar application only, Soil not on label (0.4#/acre/yr)

Alternative a.i.'s

- Dinotefuran – Valent
 - Safari 20 SG
 - Soil application on label; 0.54#/acre/yr
- Thiacloprid – Bayer
 - Calypso 4F
 - Foliar application on fruits, veggies; Soil not on the label
 - Injectable formulations available, tested

Alternative a.i.'s

- Acetamiprid – Cleary
 - TriStar 70 WSP (ornamental)
 - Foliar application only; Soil not on label
 - Trunk injection formulation tested, limited availability
- Potential soil treatment product:
 - Dinotefuran
- Potential trunk injection products:
 - Acetamiprid, Thiacloprid, emamectin benzoate