PROPHYLACTIC PESTICIDE APPLICATIONS AND LOW SPECIES DIVERSITY: DO THEY CREATE PEST OUTBREAKS IN THE URBAN FOREST?

Michael J. Raupp[1], Adrainna Szczepaniec[1], and Anne Buckelew Cumming[2]

[1]Department of Entomology, 4112 Plant Sciences, University of Maryland, College Park, MD 20742

[2]Urban and Community Forestry Program, U.S. Forest Service, Northern Research Station, 180 Canfield St., Morgantown, WV 26505

ABSTRACT

In light of catastrophic tree losses caused by Dutch elm disease, foresters recommended that the urban forest be diversified. The intent was to create a more sustainable urban forest that would not be decimated by a single pathogen or insect pest. However, recent introductions of deadly borers such as Asian longhorned beetle (*Anoplophora glabripennis*) and emerald ash borer (*Agrillus planipennis*) reveal that new introductions can have disastrous consequences for urban forests. We recently conducted a study to assess the threat to street trees imposed by Asian longhorned beetle and emerald ash borer in 12 cities in eastern North America if they become established and eradication programs are put into place. We collected a sample of tree inventories, identified the most common genera of trees, and enumerated the proportion of trees that might be at risk if these borers escaped quarantines and became widespread. Cities included in the study were Wilmington, DE; Chicago, IL; Lincolnshire, IL; Marion, IN; Florence, KY; Mt. Rainier, MD; Ann Arbor, MI; Kansas City, MO; New York City; Gastonia, NC; Toledo, OH; and Toronto, Canada (Raupp et al. 2006).

Thirty-two genera of trees encompassed the 10 most common trees found in the 12 cities studied (Raupp et al. 2006). The most common genus of street tree was *Acer*. Maples were found in all cities where they made up approximately 15 to 57% of the street trees (Fig. 1). The next most common genera were *Fraxinus* and *Quercus*. Both were among the 10 most common street trees in 9 of the cities inventoried. *Gleditsia*, and *Ulmus* were found in the top 10 lists for 8 of the cities, and *Malus*, *Prunus*, *Pyrus*, and *Tilia* were found in 7 lists of 10 most common trees. Several of the most common genera encountered such as *Acer*, *Fraxinus*, *Ulmus*, and *Platanus* are known to be acceptable hosts for these exotic borers (Herms et al. 2004, Sawyer 2005).

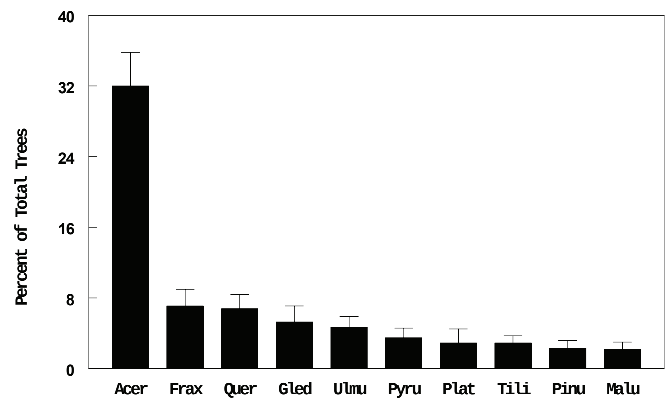

Figure 1. The 10 most common genera of street trees in 12 cities in eastern North America. Bars represent means and vertical lines represent standard errors. Acer = Acer, Frax = *Fraxinus*, Quer = *Quercus*, Ulmu = *Ulmus*, Pryu = *Pyrus*, Plat = *Platanus*, Tili = *Tilia*, Pinu = *Pinus*, Malu = *Malus*.

We suggest that losses associated with Asian longhorned beetle and emerald ash borer would be quite dramatic in terms of the proportion of trees killed, those subject to removal and replacement as part of eradication programs, and those that will require ongoing protection by one or more insecticide applications if both borers become widespread in the eastern United States. The cities included in this study face the loss or need for insecticide protection of 29 to 70% of their street trees (Raupp et al. 2006). The average percentage of trees at risk was 49.7% (4.0% s.e.). This estimate may be conservative. Recently, Morewood et al. (2003) demonstrated that red oak, *Quercus rubra*, was used for oviposition and supported larval development. They recommended that red oak be considered a potential host when surveys are conducted to detect infested trees. Host associations for Asian longhorned beetle and emerald ash borer in Asia include several genera for which no current information is available in the United States. The introduction of deadly, exotic insect pests such as Asian longhorned beetle and emerald ash borer could have devastating effects on urban forests if they escape Federal quarantines and become widespread. Urban foresters should take steps now to diversify the types of trees that are planted in cities to avoid catastrophic tree losses or massive and expensive tree protection programs.

One approach to dealing with these deadly exotic borers is to treat trees on a preventative basis with insecticides. This approach has been taken in New York City, home to one of the last great stands of American elm (*Ulmus Americana*). In 2002, Asian longhorned beetle was detected in New York City's Central Park. As part of a USDA eradication program, several thousand trees have received prophylactic treatments with the systemic pesticide imidacloprid since 2002. Since 2003, we have tracked spider mite populations on treated and untreated elms in Central Park. In each year of our study, trees treated with imidacloprid have had significantly greater densities of mites than untreated trees (Fig. 2, Raupp and Szczepaniec, unpublished).

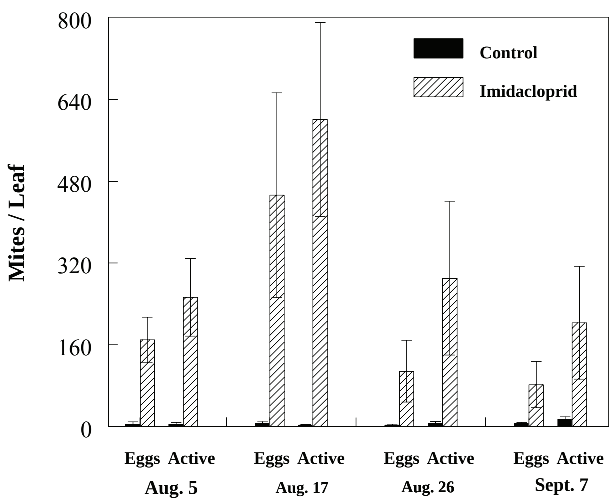

Figure 2. Abundance of *Tetranychus schoeni* on treated and untreated elms in Central Park. Bars are means and vertical lines are standard errors.

We currently have research projects underway to understand ecological processes in urban landscapes and how the disruption of these processes leads to pest outbreaks. In particular, we are elucidating the mechanisms that underlie mite outbreaks that follow the application of neonicotinoids such as imidacloprid that are used preventatively and therapeutically in eradication and management programs for exotic borers. Mite outbreaks have been reported in several systems involving landscape plants and agronomic crops. Disruption of natural enemies is one of the mechanisms proposed to explain these outbreaks (Sclar et al. 1998). In the nursery and laboratory, we will measure the effects of systemic applications of neonicotinoids on the survival and performance of important predators of spider mites: minute pirate bugs, spider mite destroyers, predatory mites, and lacewings. Also, we will test the effect of neonicotinoid exposed prey on these predators. We will survey phytophagous mites and natural enemy communities found on untreated and imidacloprid treated boxwoods, cotoneasters, and elms. A second mechanism that could underlie mite outbreaks is the stimulation of reproduction in mites caused by sublethal exposure to imidacloprid—hormoligosis (James and Price 2002). We will investigate the phenomenon of hormoligosis using three plant-spider mite associations. Finally, using plant growth measurements and phytochemical analyses, we will investigate the possibility that neonicotinoids alter the patterns of resource allocation and quality of host plants as food for mites. Our work is supported by the Tree Fund of the International Society of Arboriculture and by the National Research Initiative of the USDA Cooperative State Research, Education and Extension Service, Grant Number (2005-00915).

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