BIOLOGY AND MANAGEMENT OF LINDEN BORER: RESEARCH UNDERWAY

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Little is known about the biology and management of the linden borer, a serious insect pest of shade trees in nurseries and urban landscapes in Wisconsin. The linden borer is a native species that is common throughout northeastern North America. Over the past decade, an increasing occurrence of damage associated with the linden borer has been reported on city street trees and in nurseries throughout Wisconsin.

Currently, research is being conducted in southeast Wisconsin within the city of Milwaukee to determine the most effective and economical chemical control treatments to reduce larval linden borer infestations on several cultivars and species of *Tilia.* Three systemic insecticide treatments are being evaluated: imidacloprid (Merit™) and thiamethoxam (Meridian™) applied as a soil injection treatments and disulfoton (Di-syston™) applied as a granular soil application. Soil injections were made in November 2002 and November 2003, and the Di-syston™ applications were made in early June 2003 and April 2004. The number and location of linden borer adult exit holes were recorded, and field cages were constructed and positioned just below the first lateral branches above the ground to capture emerging adults. Trees have been examined regularly throughout the last growing season and the present season. The number of emergence holes will provide the information needed to assess respective treatments. This study should also provide information regarding the seasonal biology and life cycle of this important pest in Wisconsin.

Additional research is underway at a nursery in southeast Wisconsin where susceptible and resistant species and respective cultivars of *Tilia* are being evaluated. Five *Tilia* cordata cultivars, 'Greenspire,' 'Corinthian,' 'Chancellor,' 'Glenleven,' and 'Shamrock,' and two *Tilia americana* cultivars 'Redmond' and 'Lincoln' were planted in the nursery in April 2003. Trees are examined

regularly for oviposition events and larval activity sites from early-May through early-October 2003 and are also currently being checked regularly. These data should provide insight as to susceptible *Tilia* cultivars and species of the linden borer and also provide more information regarding the biology of the linden borer.

Because chipping of felled trees is a standard practice in the green industry for tree disposal, an additional study is being conducted to determine whether chipping is an effective means of destroying linden borer infested wood. Six dying 'Greenspire' linden trees were acquired from various locations. Each trunk was quartered longitudinally and one quarter was chipped by a Bandit Model 250 chipper and one quarter was chipped by a Bandit Model 90 chipper. The remaining quarters were cut into firewood length pieces, and one quarter was covered with aluminum screening and left outside and the other was covered in aluminum screening as well, but placed in a controlled environment to account for cage effects. Separate chip piles were made for each chipper type and placed in a completely randomized design at a location in Jackson, WI. Chip piles were covered with aluminum screening, and the number of adults captured will be compared among treatments (i.e., trunk quarters) to determine the effectiveness of chipping wood infested with linden borer larvae.

Lastly, another study is being conducted to determine the number of larval instars of linden borer. Determining the number of instars is an important key to learning more on the biology of this important pest. Four *Tilia cordata* cv. 'Greenspire' linden trees with over 50% dieback were obtained from three different cities in Southeastern Wisconsin. An average of 22.7 feet of the trunk wood from the ground up was taken to the lab in approximately two-foot sections for examination. Larvae were removed and a multitude of morphological measurements were taken from over 1500 larvae.

The value of the linden tree as an ornamental, shade, and street tree is likely to dramatically rise over the next few years, especially due to the fact that other popular trees, such as ash and maple, are targets for other potentially invading insects including the emerald ash borer (EAB) and the Asian long-horned beetle (ALB). The primary objective of this research is to gain a more comprehensive understanding of the biology of the linden borer and to develop effective management strategies that will help nursery growers, landscape managers, arborists, golf course superintendents, municipal park managers, homeowners, and others effectively manage this important ornamental insect pest in a cost effective manner.