IMPACTS OF IMIDACLOPRID ON TARGET AND NON-TARGET SPECIES ON HEMLOCK

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Abstract

Hemlock woolly adelgid, *Adelges tsugae* (Annand), is a very serious pest of hemlocks, *Tsuga* spp., in the eastern United States. Although a variety of insecticides are capable of controlling hemlock woolly adelgid, the systemic insecticide, imidacloprid has gained widespread acceptance and use in the plant care industry. While several studies demonstrate the efficacy of imidacloprid in reducing adelgid populations, none have examined how hemlocks recover following imidacloprid therapy. Specimen trees in a residential landscape were treated with soil drenches of imidacloprid in March of 1999 or left untreated. Trees were in three stages of canopy appearance at the time of the application, healthy, poor, or with dieback. On the day of application and at 434 and 816 days after application the abundance of hemlock woolly adelgid was determined. Furthermore, the amount of new growth, DBH, and appearance of the plants were also quantified. Imidacloprid provided remarkable and long lasting levels of control on all categories of trees. Adelgids were virtually absent on all treated trees, even trees with appreciable dieback more than 2 years following the application despite the fact that adelgids were present in the same landscape on trees nearby. Hemlocks recovered dramatically once the pressure of the adelgids was removed following an application of imidacloprid. The amount of new growth increased dramatically as did the appearance of the trees. We could not detect a significant difference in the increase in caliper of trees in the different health categories following the application of imidacloprid. However, there was a clear trend for trees released from adelgid pressure to increase in caliper. Trees in the best health generally experienced the largest gains. More importantly, the response of trees to imidacloprid therapy differed in relation to their condition at the onset of the experiment. With respect to the amount of new growth and appearance, trees with the healthiest canopy at the onset of the experiment improved the least following the reduction in adelgid populations. Trees in poor condition, that is, with little new growth but no dieback, recovered the quickest and most dramatically. Trees in the poorest condition at the onset recovered impressively but more slowly. Trees left untreated remained ugly and in poor health. These results confirm the value of imidacloprid in reducing adelgid populations and improving the quality of hemlocks under attack by the hemlock woolly adelgid in urban forests (Webb et al. 2003).

By the end of the 1990s scientists at the University of Maryland (Raupp), Beltsville Agricultural Research Center (Webb), and Bartlett Tree Experts (Booth) received reports from commercial arborists and landscape managers that mites and their injury seemed to be more common on hemlocks treated with imidacloprid. Due to the widespread use of imidacloprid for control of hemlock woolly adelgid and growing concerns raised over increased mite problems following the application of imidacloprid, two independent studies were conducted. The first by Webb and Raupp examined the effects of imidacloprid on the abundance of spruce spider mite, *Oligonychus ununguis* (Jacobi), and the hemlock rust mite, *Nalepella tsugifolia* Keifer and their damage on Canadian hemlocks, *T. canadensis* (L.) Carrière, in a residential landscape. The second by Raupp, Szczepaniec, Booth, and Ahern compared hemlock rust mite abundance and spruce spider mite injury on treated and untreated Canadian hemlocks in parks, gardens, and residential landscapes in the Washington-Baltimore metropolitan area. The objectives of the studies were twofold. First, we wanted to know if mites were more or less abundant on imidacloprid treated trees compared to untreated ones. Second, we wanted to know if mite injury was greater or less on trees treated with imidacloprid compared to untreated controls.

Hemlocks were treated with soil drenches or soil injections of imidacloprid. In a residential landscape we found populations of spruce spider mites, hemlock rust mites, and their injury to be greater on hemlocks treated with imidacloprid than on untreated trees. A survey of hemlocks in gardens, parks, and residential landscapes revealed that hemlocks treated with imidacloprid were more likely to be infested with spider mites but not rust mites. Moreover, terminals on imidacloprid treated hemlocks were approximately nine times more likely to have severe needle damage than untreated trees. Arborists and landscape managers applying imidacloprid to hemlocks should carefully monitor mite populations on treated trees and be prepared to intervene should mite populations increase (Raupp et al. in press).

We are currently investigating the reasons for increased mite abundance and injury of hemlocks treated with imidacloprid. Three hypotheses have been suggested to explain greater mite abundance on plants treated with imidacloprid. One suggests that sublethal doses of imidacloprid may stimulate the reproduction of these pests. This phenomenon is known as hormoligosis (Luckey 1968). A second mechanism to explain increased mite abundance on imidacloprid treated plants is the elimination of natural enemies or suppression of their activities. We have preliminary evidence that woody plants treated with imidacloprid can be lethal to predatory omnivores such as minute pirate bugs. Sclar et al. (1998) suggested that suppression of natural enemies such as minute pirate bugs might be a factor contributing to greater levels of spider mites and their injury on honeylocust trees treated with imidacloprid. A third hypothesis for increased mite populations on imidacloprid treated plants has been proposed by researchers at the Bayer Corporation (Royalty 2003). This hypothesis suggests that imidacloprid alters the physiology of the plant in a way beneficial to phytophagous mites. Improved nutritional quality of leaves may result in enhanced mite performance such as increased fecundity.

References

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