Research Note

TRANSLOCATION OF IMIDACLOPRID IN THREE TREE SPECIES WHEN TRUNK- AND SOIL-INJECTED

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Imidacloprid is the active ingredient contained in Merit, a systemic chloronicotinyl insecticide used for insect control in the turf and ornamental market. Merit has been effective in controlling a wide range of tree and shrub pests including adelgids, aphids, lace bugs, leafminers, mealybugs, scales, thrips, whiteflies, elm leaf beetles, leafhoppers, and Japanese beetles (Dotson 1994). Merit controls pests both by contact and ingestion and can be applied as a foliar, soil, or trunk treatment (Mullins and Christie 1995). Because Merit is systemic, it can be effectively applied as a soil treatment to the root system or injected directly into the trunk. This reduces or eliminates problems associated with foliar sprays, such as drift, wet foliage, dermal exposure, and impact on foliage inhabiting beneficial organisms. Limited information is available on the amount of time required by Merit to translocate through the plant when soil- or trunk-applied, and this is solely based on insect bioassays. The purpose of this study was to determine the movement of Merit quantitatively in soil- and trunk-injected trees by periodically taking foliage samples from treated trees and having the samples chemically analyzed.

Materials and Methods

Eastern hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), and pin oak (*Quercus palustris*), which were 45.7 to 50.8 cm (18 to 20 in.) diameter at breast height (dbh) were either soil or trunk-injected on June 29 and 30, 1994, between 0800 and 1200 h. All trees used in this study were visually healthy and located on the University of Massachusetts campus at Amherst, Massachusetts. The trees were a part of the campus landscape, with grass predominantly surrounding them, and the soil type was sandy loam with moderate soil moisture. Weather conditions at time of application were 24°C to 27°C (75°F to 80°F), with 70% to 80% relative humidity, < 13.3 kph (< 8 mph) wind, and clear to partly cloudy.

Soil injections were made according to the label directions of the Merit 75 WP formulation of imidacloprid at the rate of 1.5 g/in.dbh (1.25 g a.i/in. dbh) in 2 gal solution per in. dbh. A 189 L (50 gal) hydraulic sprayer operating at 200 psi with a standard soil-injector needle was used to apply the material 20.3 to 30.5 cm (8 to 12 in.) below the soil surface.

Trunk injections were applied using Mauget (J. J. Mauget Company, Arcadia, California) capsules containing 3 mL of a 15% imidacloprid formulation (0.225 g a.i/in. dbh). The number of capsules per tree was determined by dividing the total dbh by 2. The Mauget capsules were placed at the root flare in accordance with the application instructions contained in the Mauget Self Study Manual.

For each treatment, 1 tree of each pair of tree species was soil- or trunk-injected. To enable comparison of imidacloprid movement when either soil- or trunk-injected, pairs of each tree species that were similar in location, size, and environmental surroundings were selected.

Four hundred g of foliage were taken at 0, 1, 2, 4, 8, and 12 wk after treatment from each treated tree. Foliage samples from *T. canadensis* and *P. strobus* were also taken 16 and 20 wk after application. Foliage samples were taken from the mid- to upper crown between 1000 and 1400 h and placed in plastic bags, immediately frozen, and held at –70°C (–94°F) until the samples were analyzed in January 1995, using the total method as developed by Placke and Weber (1983).

Results and Discussion

In a study performed by Bayer AG (Elbert et al. 1991), the LC_{95} (lethal concentration to kill 95% of the test population) of imidacloprid for the bean

aphid (*Aphis fabae*) and the green peach aphid (*Myzus persicae*) was found to be approximately 0.15 ppm. This concentration can be used as a general reference point at which mortality may be anticipated to occur to sucking tree pests listed on the Merit 75 WP or WSP label. Thus, the reference lines at 0.15 ppm on Figure 1 indicate the approximate point at which the level of imidacloprid is high enough to cause mortality.

When imidacloprid was soil-applied, 8 to 12 wk were required to reach lethal concentrations in the 3 tree species (Figure 1). Imidacloprid concentrations rose the fastest in *Q. palustris,* followed by *P. strobus* and *T. canadensis.* When imidacloprid was trunk-injected, lethal concentrations for both *Q. palustris* and *T. canadensis* occurred by 1 and 4 wk, respectively (Figure 1). Translocation of trunk-injected imidacloprid in *P. strobus* required approximately 5 mo before attaining the lethal concentration. The concentration of imidacloprid in trunk-injected trees increased in *Q. palustris* and *T. canadensis* and then began to decline over time, but the concentration of imidacloprid continued to increase throughout the study for *P. strobus.* For both *Q. palustris* and *T. canadensis,* imidacloprid moved through the tree more quickly when trunk-injected than when soil-injected; however, soil injection of imidacloprid moved through *P. strobus* faster than trunk injection.

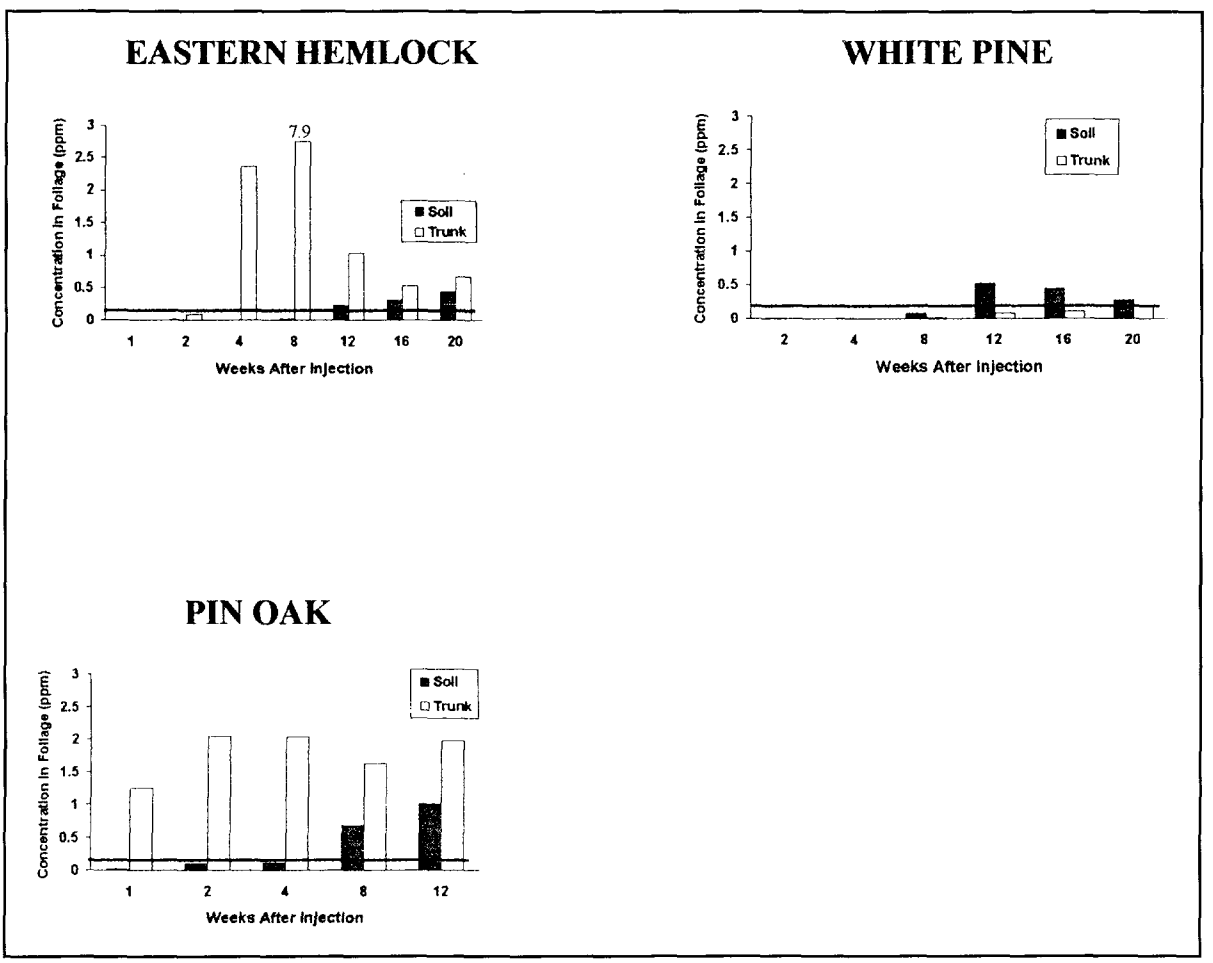

Figure 1. Concentration of imidacloprid in the foliage of 3 tree species when soil- or trunk-injected. The 0.15 ppm reference line indicates the level at which aphid mortality due to imidacloprid is expected.

These preliminary results indicate that 2 to 3 mo may be required for sufficient concentration of imidacloprid to translocate through large trees when applied by soil injection. Thus, timing of soil applications for pests attacking large trees may need to be made in the fall if the targeted life stage of the pest occurs early in the spring. For pests that occur later in the growing season, early spring applications may be appropriate. For *Q. palustris* and *T. canadensis,* trunk injection of imidacloprid moved very quickly through the tree (< 4 wk) as compared to soil-injection treatments. Trunk injection of imidacloprid may be useful for situations in which quick control of a pest problem is desired, whereas the soil injection may provide a more long-term solution.

Because the data generated in this study were from single trees of each tree species, a further indepth study has been initiated to quantitatively evaluate Merit in deciduous (white birch, *Betula alba*) and evergreen, *T. canadensis*) tree species. The objective of this followup study will be 1) to validate the information found in the 1st study on the uptake of Merit in treated trees, 2) to determine the persistence of Merit in trees treated by soil injection, 3) to evaluate whether application timing (spring or fall) affects uptake of Merit, and 4) to determine whether the use of liquid fertilizer during application has an effect on the uptake of Merit in trees.

Literature Cited

Dotson, J.A. 1994. Bayer Corp., MERIT Product Information Manual. 110 pp.

Elbert, A., B. Becker, J. Hartwig, and C. Erdelen. 1991. *Imidacloprid—A new systemic insecticide.* Pflanzenschutz-Nachrichten Bayer 44(62): 113–136.

Mullins, J.W., and D. Christie. 1995. *Imidacloprid: A new nitroguanidine Insecticide.* Am. Chem. Soc. Sym. Ser. 524:183–198.

Placke, F.J., and E. Weber. 1983. Method of determining imidacloprid residues in plant materials. Pflanzenschutz-Nachrichten Bayer 46 (2):109–182.

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