Soil Application of Imidacloprid to Control Hemlock Woolly Adelgid: Best Management Practices

Richard S. Cowles
Connecticut Agricultural Experiment Station
Valley Laboratory, Windsor, CT 06095

Best Management Practices

With imidacloprid applications in forests, the movement of the chemical into aquatic environments must be minimized to guarantee that concentrations are kept far below toxic levels. Imidacloprid binds tightly to organic matter, especially when the chemical is present at low concentrations, yet it can also move rapidly through highly organic soil if applied under saturated conditions. Applications that maximize the binding of imidacloprid with organic matter will immobilize the active ingredient so that it can more readily be picked up by the tree’s roots, while preventing movement to groundwater or nearby aquatic environments. The best way to achieve these goals are to apply imidacloprid (1) as a shallow subsurface injection, (2) dispersed near and around the tree’s base, (3) using the lowest effective labeled rate (0.75 g active ingredient per inch d.b.h.), and, most importantly, (4) when the soil is moist but not saturated. Currently, some managers keep a 50-foot buffer zone around streams, within which trees may only be treated via trunk injection.

Background

Hemlocks have special value to the environment when they grow near streams and neighboring aquatic resources. Protecting these trees from hemlock woolly adelgid (HWA) with insecticides risks polluting the aquatic environment. At present, the most effective insecticide is imidacloprid, available as the Merit 75W formulation for soil application. Imidacloprid has sufficient water solubility to move in sap throughout a tree, allowing nearly complete HWA control within 2 years of soil application. However, this same water solubility could threaten nearby aquatic resources. Clearly, limiting the risk of imidacloprid movement into streams and groundwater should be a high priority when treating hemlocks.

Insecticide toxicity can be predicted based on three factors: (1) the innate sensitivity of the exposed organism, usually measured as its LD$_{50}$ or LC$_{50}$ value, (2) the concentration of the poison, and (3) the duration of exposure of the organism to the poison.

For Factor 1, the toxicity of imidacloprid to aquatic organisms is known from tests required of Bayer Corporation for registration. Susceptible aquatic species include Mysid (saltwater) shrimp, the amphipod Hyalella spp., and chironomid (midge) larvae, with LC$_{50}$ values of 34, 55, and 69 parts per billion (ppb), respectively. For Factor 2, the concentration of imidacloprid that will result in nearby streams from soil application is unknown. However, the concentration found in the sap of treated trees typically ranges from 5 to 35 ppb, with most values closer to 5 ppb. If this represents the concentration of imidacloprid present in the mobile soil solution, then there is little risk to aquatic organisms following soil-based applications. For Factor 3, Bayer Corporation registration data show that imidacloprid breaks down very quickly when exposed to sunlight. Imidacloprid in water solution exposed to sunlight has a half-life between 4 hours and 1.4 days. Furthermore, once imidacloprid enters a stream, it mixes with the uncontaminated water, quickly diluting it to nontoxic concentrations. However, imidacloprid bound to organic sediment could settle to stream bottoms, where residues would be protected from sunlight and persist longer than if present in solution. Therefore, it is especially important to prevent applications that result in surface runoff of particles containing imidacloprid, because these residues could persist long enough to be toxic to aquatic organisms.