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Tree Injection as a Conservation Tool?

The application of pesticides to control plant insects and diseases is sometimes necessary to assure that trees and shrubs function properly in a conservation application. If plants are not healthy, they can not provide optimum conservation benefits and may, over time, become susceptible to a host of secondary stresses. Although pesticides help protect our natural resources, they can, if misused or over applied, cause serious damage as well. There are several things that conservationists and homeowners can do to reduce the risk of applicator and environmental exposure to pesticides. One potential tool for use in trees and large shrubs is **microinjection**. Since I recently tried microinjection for the first time, I thought that I would share some general information, as well as my particular experiences.

Commercial microinjection has been around for more than 20 years. This system can be used for insecticides, fungicides, miticides, antibiotics, and fertilizers. Microinjection involves drilling a small hole into a tree to a depth of 0.25 to 0.50 inches below the bark:cambium interface. A low-pressure injector is then installed that delivers 2 to 10 milliliters of concentrated chemical into the vascular system of the plant. The chemical is translocated to virtually all plant parts. The injector is manually pressurized; you squeeze a piston to pressurize the unit. Only a small amount of pressure is normally needed to “infuse” the chemical in to the xylem sap of the tree (it appears there are exceptions). The number of injectors needed per tree is based on tree circumference. As an example, a 36-inch circumference tree would require ~6 injectors if 1 injector is recommended for every 6 inches of circumference. The injectors are typically evacuated within 24 to 48 hours, with pest control beginning shortly thereafter. Good control typically occurs within several days, although efficacy varies with species, weather, pesticide, and pest. After the injectors are completely evacuated, they are manually removed and recycled or disposed of at an approved facility. The beauty of microinjection is the accuracy of delivery, with little to no exposure of chemicals to non-target pests and animals. With proper protective gear, exposure to the applicator is minimal. With conventional delivery systems such as a high-pressure sprayer or aerial application, drift and over-spray may be problematic. Rain, wind, and sprinkler irrigation systems do not effect microinjection installation and efficacy because the injector units are self-contained.

My experience with injection began earlier this summer with an outbreak of mountain pine beetle in our Hunter Germplasm ponderosa pine (*Pinus ponderosa*) seed orchard. The Extension Service recommended cutting and burning infested trees, the standard treatment when an infestation is localized, or of such magnitude that control is impractical or cost prohibitive (such as in a forest). Since this was a very high value crop, the expense of treatment was justified. The problem with mountain pine beetle is that the damage is caused by the larval stage, which is protected inside the tree. Conventional control targets the adult beetle as it emerges from the tree, but timing is critical and may require repeated applications. Microinjection was recommended as a method of controlling both the larvae in the tree and as a preventative against re-invasion by adult beetles later in the season. Based on this advice, we installed 600 injectors in 200 trees in about 35 person hours. We also installed 10 units on a Siberian elm *Ulmus pumila* heavily infested with elm leaf beetle and aphids, and 10 units a green ash *Fraxinus pennsylvanica* with mites.

The treatment of the Siberian elm and green ash was textbook. The injectors emptied within 72 hours of installation and control began shortly thereafter. The ponderosa pine treatment did not go as well. Some injectors leaked chemical past the pressure pump gasket, although our use of chemical resistant gloves prevented exposure. A few injectors cracked as we seated the tip through the septum (i.e., hitting the unit with a rubber mallet), but the chemical merely leaked onto the surface of the bark. The big problem was that the pines produced large amounts of pitch that back filled into the injectors and prevented uptake of the chemical by the tree. Although some chemical appeared to be eventually absorbed, I could not find any evidence of mountain pine beetle or aphid control. Industry representatives indicated that microinjection of conifers is less successful than deciduous plants, and that weather conditions and water stress may have been involved. There was some lateral discharge of chemical and sap as the units were removed, but the industry representative indicated that was unusual, and something specific to our ponderosa pine trees or environment. When the tree properly absorbed the chemicals, no splattering occurred. We tested two other microinjection products later in the growing season after a thorough irrigation of the seed orchard, but uptake was again limited. We finally decided to prune off infested branches and then burn them to control the larvae. A topical chemical was applied to the trees in an attempt to control adults and prevent re-invasion.

There are a few points worth considering before moving into microinjection. One criticism of microinjection is that it wounds the tree, creating a pocket of dead tissue that can form a portal of entry for insects and disease. Microinjection is only recommended for trees at least 6 inches in circumference, so it is not a viable option for small trees and multi-stemmed shrubs. As with any chemical, certain plant species may be sensitive to a given product or, sensitivity may be demonstrated under certain environmental conditions. Microinjection is generally held to be more effective with deciduous plants than conifers, primarily because of the pitch response to wounding. Microinjection is more expensive than conventional sprays, and usually requires a licensed arborist or trained ornamental and turf applicator to install. The injector units are located within the reach of children and animals, so I recommend that some type of protective structure (fence, etc.) be installed at the base of treated trees. I have no information on what would happen if birds fed on treated insects or how long the chemical remains in the plant tissue, which may be an issue for organic gardeners that mulch with leaves. The same concerns would apply with topically applied chemicals.

My personal opinion is to use less invasive treatments when the target pest is readily controlled with conventional sprays, or when exposure to people, animals, and the environment is unlikely. Reserve microinjection for high value or tall trees with serious pests that cannot be effectively controlled by other means. Trees surrounded by pavement, in high traffic areas (schools, hospitals, etc.), or close to bodies of water are also good candidates for microinjection. As an alternative, consider systemic chemicals that can be applied to the soil that are then absorbed by the tree. These chemicals have a similar mode of action as injectable products. Caution is advised when using these compounds because some are mobile within the soil profile, and could threaten groundwater supplies.

For more information on microinjection, contact a state or professional licensed arborist, your local county Extension office, University Extension specialist, or Community Forester. These individuals can determine if microinjection is warranted, as well as provide guidance on the proper selection and injection of chemicals.