

The IPM approach is as much a philosophy as it is a plan. But if you are committed to it, the change in the types of chemical products available is not likely to affect how you do business. Inspection visits and spot treatments will not be affected — only the names may change.

If you have more of a treatment focus, however, expect shorter residual controls and higher material costs, as well as other adjustments.

Ease into it

Tom Smith, president of Grass Roots Inc., East Lansing, MI, believes that any



business can begin to incorporate IPM principles at a pace and level that is comfortable. It does not have to be an all-or-nothing proposition.

In fact, according to Smith, attempting to implement IPM in one fell swoop can be a daunting task. Smith recommends implementing certain IPM principles for a gradual transition to a comfortable level. For example:

- ▶ target pesticide applications, both in timing and for specific pests
- ▶ offer additional management services
- ▶ take soil samples to test for fertilizer recommendations
- ▶ develop fact sheets explaining cultural practices and pest problems, in a language your customer can understand.

Grass Roots relies heavily on horticultural oils to manage insects, especially soft-bodied insects. The company also uses insecticidal soaps and started using Mach2 last

year. For weed control, Smith has been using corn gluten meal for some accounts (including his own lawn), and seeing success.

What's rational about biorationals?

While most people understand that true "biological" control refers to predator, parasite or pathogen, the other terms can be a bit more confusing. Even among researchers, there seems to be some difference in how the terms are used:

▶ "Biologically based" products refer to toxins or chemicals that are extracted from biologicals (usually pathogens) or are naturally occurring plant products (botanicals). For example, Bt is a biologically based product because it does not cause an infection in the pest but produces a toxic protein that eats away at an insect's gut lining. Since it is protein toxins that the Bt bacterium produces that are used, Bt is not a "biological."

▶ "Biorational" means biologically (environmentally) rational control materials. This means things that have few or no adverse side effects. It can include synthetic materials like halofenozide (Mach2), which is a molting regulator that affects only a limited number of target insects, true biologicals like Naturalis (contains spores of *Beauveria* fungus) or true botanicals like azadirachtin (Neem, Azatin).

Keep in mind that there are biologically based products that are not considered as biorationals. Powerful biologicals related to botulism and anthrax bacteria, with a broad spectrum of activity (including humans), or botanicals like nicotine sulfate could not be considered as rational control materials.

—Dave Shetlar, Ph.D., Associate Professor of Landscape Entomology at OSU, Columbus, OH

year. For weed control, Smith has been using corn gluten meal for some accounts (including his own lawn), and seeing success.

Use your resources

Jody Mills, staff horticulturist with Broccolo Tree and Lawn Care, Rochester, NY, says that the company is only beginning to use some of the newer biorational products

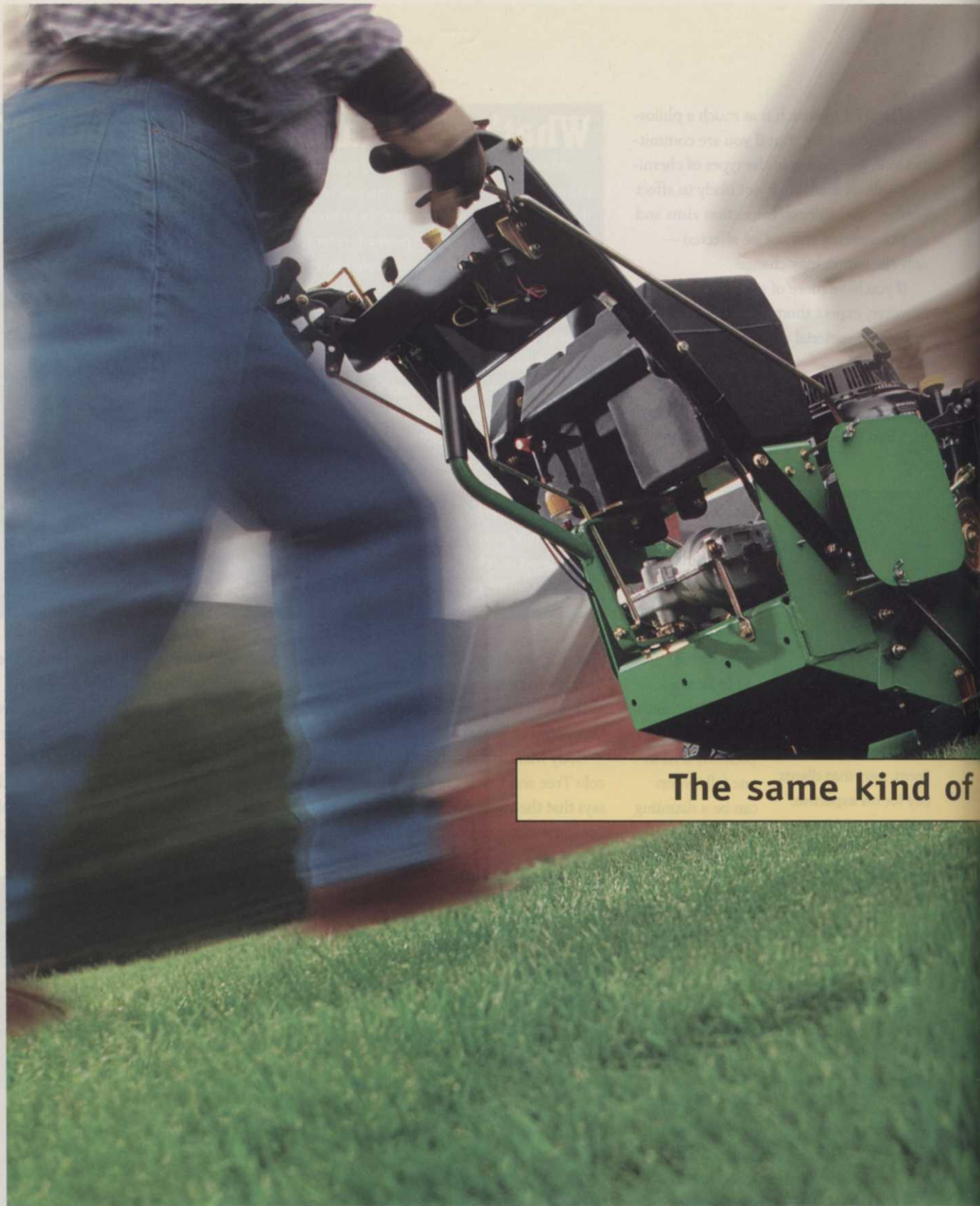
such as Conserve[®], but believes that they will mesh well into the IPM program.

Mills says that the Cornell Cooperative Extension-Monroe County provides them with vital information on pests and their stages. The company also tracks degree-days. Combined, these resources allow Broccolo's

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Broccolo Tree and Lawn Care staff are always on the lookout for insects, of all sizes.

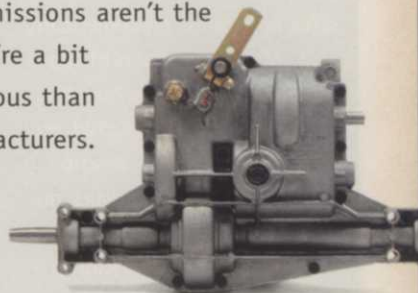


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Test it yourself

If you want to be sure a product will fit your needs, test it. Wendy Gelernter, Ph.D., of PACE Consulting in San Diego, CA, says, "The only way to gain more confidence that a management system is the best for your site is to start a testing program."

Self-tests can ensure that the products and practices you choose fit your specific circumstances, conditions, site variations, equipment and management style.

- ▶ Plan your test before you begin; map out your plans
- ▶ Identify and record:
 1. Objectives — "What rate will result in good pest control without damaging the foliage?" or, "How does the new product compare to a product that I have been using?"
 2. Materials — products, rates, application equipment, etc.
 3. Methods — dates of application and evaluation, how the evaluations were conducted, etc.
 4. Observations — descriptions of visual characteristics, numerical ratings (e.g. the weight of clippings) or relative ratings (e.g. assigning estimates of performance on a scale).
 5. Summary — of the answers to your questions.

Do not omit any of these components or it will be difficult to determine what happened during the test or why it happened.

▶ For each test, maintain an area that receives no treatment. Make sure the untreated (control) area is the same size and managed in the same way. Try to have the untreated area and testing plot next to each other, so the sites have similar conditions. And, the two areas should look the same at the start of the test, so you can easily compare the effect of the treatment.

▶ Size it properly. The smallest test plot recommended by Gelernter is 4 x 4 ft. For most small plot work, however, a 5-ft. by 10-ft. plot is convenient for a sprayer that applies a 5-foot-swath width. Or simply divide an area in half, leaving one half untreated and the other half treated.

Finally, once your tests are completed, don't take off your research hat. Follow an unwritten rule of grassroots product and practice testing — share your results with others. □



The test and control sites should have similar conditions. The foreground of this photo shows weed control along a driveway, in Oct. 1998, following two applications of corn gluten meal by Tom Smith in June 1997 and May 1998. The untreated comparison is directly behind.

Corn gluten meal: new weed and feed?

Corn gluten meal (CGM) is the dried protein residue from corn after removing the larger part of the starch and germ and separating the bran. This by-product contains 10% nitrogen by weight. Tom Smith of Grass Roots says two applications a year provides about 4 lbs. N/1,000 ft and unless a property needs phosphorus or potassium, he doesn't need to make additional applications.

It takes a lot of CGM for 1,000 sq.ft. and there is increased material costs. Smith estimates 20 lbs./1,000 sq. ft. costs about \$12 from North Country Organics in Vermont (www.norganics.com). Treatment for a 10,000-sq.ft. lawn would cost a client about \$200. This is a big increase over traditional programs, but Smith says that treating twice a year, as opposed to five or more times, reduces the difference in yearly costs.

While not as fast-acting as traditional preemergents, Smith sees CGM as a viable alternative for some properties. "Clients that are interested in reducing or eliminating pesticide use, clients that are very concerned environmentally and clients that traditionally would not sign up for any type of lawn care," he says. Another client is the City of East Lansing, where Grass Roots has a pilot project for a very visible median, about three acres in size. While the city cannot afford more than a single treatment in the spring (which slows the impact of the CGM), he can still see results, says Smith, who is a CGM distributor. □

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technicians to time inspections and treatments before outbreaks get out of hand.

Educated workers are another resource that the company uses and is committed to fostering. Mills believes that it is essential because they are the people who "make the decisions when on the property, what they're going to treat or how much they're going to fertilize, if at all."

The company emphasizes communication to keep employees informed about pest and disease problems. Mills says, "Employees get a lot of hands-on experience and constant training as to what to be looking for, when to be looking for it."

Keeping employees informed, says Mills, "makes the difference, because we have to count on catching these things at the earliest time."

You're the expert

Probably the biggest stumbling block for most businesses is selling expertise, rather than a service. This is an idea that may take some getting used to, but both

COMMON TURFGRASS INSECTICIDES CURRENTLY UNDER FQPA REVIEW:

| Common Name | Examples of trade name | Class | Pests commonly treated |
|--------------|------------------------|-----------|---|
| carbaryl | Sevin | carbamate | caterpillars, white grubs, chinch bugs |
| bendiocarb | Turcam | carbamate | white grubs, chinch bugs |
| chlorpyrifos | Dursban | OP | mole crickets, caterpillars, fire ants, chinch bugs, billbugs |
| acephate | Orthene | OP | mole crickets, caterpillars, fire ants |
| trichlorfon | Dylox | OP | white grubs |
| isofenphos | Oftanol | OP | white grubs, mole crickets, billbugs, chinch bugs |
| ethoprop | Mocap | OP | mole crickets |

RICK BRANDENBURG, PH.D., TURFGRASS ENTOMOLOGIST, NCSU

Smith and Mills confirm the need to sell expertise, not treatment visits.

Smith says, "Since IPM is information based, rather than product based, it is important to feel comfortable selling service, which is what most professionals sell." Smith compares himself to plumbers, mechanics and other professionals who charge for their expertise.

This is where Mills agrees: "We have to market ourselves more as consultants."

Keep ahead of the wave

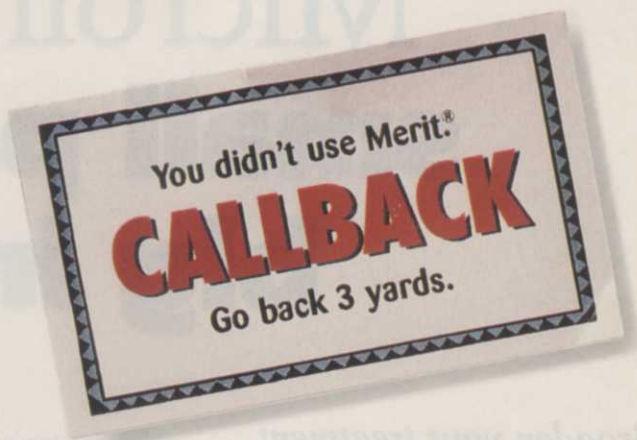
Change, including the possibility of the loss of some familiar chemical products arising from implementation of FQPA, is inevitable. Familiarize yourself with the "kinder, gentler products," on your own property if necessary. Don't get blind-sided by new products and new regulations. Know what your product options are and how they can work for you. **LM**

SOME BIORATIONAL CONTROL CHOICES

| Brand | Problem |
|--------------------|---|
| Avid | leafminers, mites |
| Azatin | broad spectrum IGR |
| BioNeem | broad spectrum IGR |
| Conserve | caterpillars, larvae of leaf-feeding beetles and sawflies |
| DiTera | nematicide |
| Matth | caterpillars |
| Meritl | grubs, leaf miners, aphids, etc. |
| Neemazad | broad spectrum IGR |
| Mach2 | IGR |
| Hexygon | miticide |
| insecticidal soaps | |
| horticultural oils | |
| Heritage | fungicide |
| BioTrek | biological fungicide |
| Spot Less | biological fungicide |

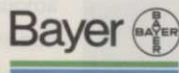


Routine monitoring that focuses on trouble spots allows diagnosis and spot treatment before problems become severe. Hot spots near walks and driveways are prime areas for Grass Roots staff to scout for chinch bugs and other pest problems.



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Microinjection: small package, big impact

Broaden your treatment options by including microinjection in your treatment program.

By TERRY A. TATTAR, Ph.D.

Problem: your client has two large elm trees being defoliated by elm leaf beetles. Solution: spray to control the beetles. Problem solved!

But what if the trees are overhanging a school yard directly beside the client's property? Or what if your client is a senior citizen's home? How do you treat a problem and also address the concerns that people may have? Microinjection is one method that might fit into your program.



Spraying street trees is not wise in all cases.

Microinjection's contained delivery system gives you an environmentally friendly alternative to spray applications, as well as low initial investment. Properly used, microinjection has tremendous potential to benefit trees while also providing added value to landscapes.

Spraying can cause concern

You can treat some pest problems, and even nutrient deficiencies, with a foliar application. But spraying community shade trees requires specialized, expensive equipment. It may not be appropriate either. What if a hospital, nursing home, school, pond, stream or river is nearby? What if your clients or their neighbors have pets, wildlife concerns or chemical sensitivities? Spraying may simply not be a suitable tree health care option.

Microinjection, however, allows the introduction of materials such as antibiotics, fungicides, insecticides and mineral nutrients directly into a tree without any contact with the environment.

Spraying, soil injection and trunk injection are the most common methods to apply tree health care treatments. Each of these techniques has a place in tree health care and each has advantages and disadvantages.

Good enough for DaVinci

Microinjection uses small amounts (approximately 0.1 ounce) of therapeutic chemicals contained in sealed capsules which are introduced into shallow trunk

SPRAYING

Pros

- quick application of materials
- rapid response to treatment

Cons

- accurate timing needed for some pests
- height of the tree can impact the level of coverage
- weather must be suitable for spraying

SOIL INJECTION

Pro

- allows combinations of fertilizers and pesticides
- causes no trunk wounds

Con

- timing of delivery is important since there can be some time delay in the uptake of the materials by the tree

TRUNK INJECTION

Pro

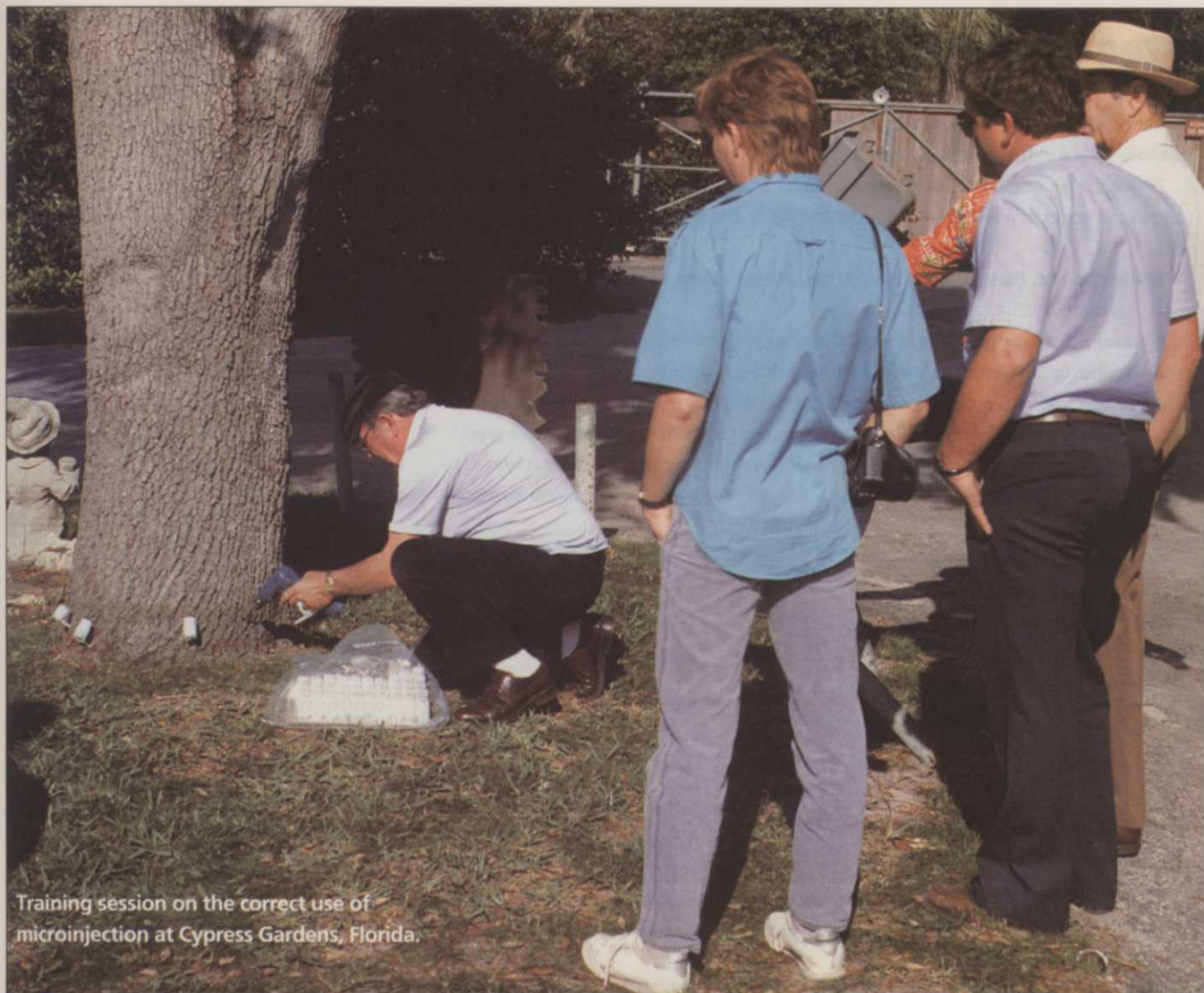
- injected materials rapidly available within the tree
- no environmental contact with pesticides can be performed under most weather conditions

Con

- must consider tree response to trunk wounding
- uneven distribution in crown may occur

No treatment method is ideal for all situations. Remember, you can combine these application systems in IPM programs for shade trees. Each situation is different, so use the best delivery systems to address the problem.

wounds around the base of a tree. The injected chemicals are distributed systematically by sap movement within the tree to



Training session on the correct use of microinjection at Cypress Gardens, Florida.

Microinjection may be a suitable:

- ▶ For use against difficult-to-control insects (e.g. bronze birch borer, scale, gypsy moth, aphids, birch leafminer etc.)
- ▶ When drift becomes a problem, such as in crowded urban areas
- ▶ In environmentally sensitive areas, such as near playgrounds, camp sites, water or wildlife areas
- ▶ As part of an IPM program, minimizing chemical usage
- ▶ For very tall trees or in poor weather conditions (wind, rain, etc.)
- ▶ To protect nontarget pests
- ▶ For difficult to control diseases
- ▶ For applying micronutrients

the branches, leaves and even roots within a few hours after injection.

Although the first reports of trunk injection of trees date to studies by Leonardo DaVinci during the Renaissance, it is often misunderstood. Materials in liquids can be injected into the woody tissues of trees (xylem), because the pressure within the xylem is below that of atmospheric pressure on the outside of the tree. Under this

condition of negative pressure, liquids introduced into healthy xylem through a fresh injection wound are taken into the xylem and distributed within the tree in the sap stream. Actually, this is not so much injection as it is the accessing of the transport tissues of the tree and allowing them to transport the chemicals up into the tree. More like infusion therapy, if you will.

You don't have to use high pressures to

"force" liquids into the tree. High-pressure injection can actually damage tree tissues and may not place the injected materials into the outer xylem where most systemic transport occurs. Low pressures sufficient to empty the injection reservoir are most effective for transport with less impact on the tree.

Trunk injection of several gallons of ma-

continued

Tree Injection 101

1. Make wounds as small and as shallow as possible. Deeper and larger wounds under higher pressures cause greater injury to the tree. Ninety percent of all conduction in the tree takes place in the current growth ring of most trees.

2. Make clean-edge wounds by using a fully charged drill and a sharp bit. The more ragged the edges of a wound, the greater the injury. Disinfect drill bit between injection sites.

3. Inject on root flares. Do not inject in the valleys between the flares where cambial growth is narrow.

4. Never place injection holes in vertical alignment; wounds directly above or below other wounds cause further injury to the tree, while uptake is poor or not possible.

When several injection periods are needed, create patterns to avoid vertical alignment.

5. Monitor previously injected trees. Do not reinject a tree if the wounds from previous injections are not closed after one year or if fluxing has not stopped. If cracking occurs at the injection site, do not inject this tree again. Not all trees can tolerate injection wounds and chemicals.

6. Do not use injection sites from the previous year.

—Marty Shaw, certified arborist, certified nursery professional and president of TIPCO Inc., Knoxville, TN. www.treedoc.com



The placement of microinjection capsules containing mineral nutrients on a shade tree is a simple process.

materials per tree, or macroinjection, has been used to treat trees with vascular diseases, such as the Dutch elm disease. Unfortunately, most tree species do not have porous xylem like the American elm and cannot accept large volumes of liquids by trunk injection. In addition, macroinjection systems involve complex tubing and reservoir systems which are labor intensive and are not practical for rapidly treating several trees.

A breakthrough in injection technology occurred in the 1960s when the systemic insecticide Bidrin, in microinjection capsules, was injected into trees and shown to

control a variety of chewing and sucking insect pests. Large volumes of materials did not need to be injected into a tree to control a problem. The Bidrin research showed that a small volume of concentrated systemic chemical in a microinjection capsule could be effective.

Since that time, microinjection research has focused on developing systemic formulations of antibiotics, insecticides and fungicides that are effective in low volumes. Re-

Wounds that don't heal

Most trees are strong compartmentalizers and close injection wounds very quickly. However, some individual trees may be weak compartmentalizers (whether due to genetic characteristics or compromised health) and should not be injected. Know the danger signs of weak compartmentalization:

- ▶ delayed wound closure
- ▶ vertical cracks above or below the wound
- ▶ prolonged fluxing from the wound with discolored or odorous discharge
- ▶ expansion of the wound or canker formation around the wound

cently, combinations of an insecticide and a fungicide in a single capsule have been developed to treat both insect and disease problems with a single injection.

Before you begin

Microinjection can only be effective if applied by trained applicators who have correctly diagnosed a tree health problem. An incorrect diagnosis will likely result in the use of an ineffective material.

Improper application can harm a tree. Companies that sell microinjection products usually require training before using their products. Both the J.J. Mauget Co. and Tree Technology Systems Inc., for example, require a training program before sale and use of their products. In addition, microinjection capsules must be applied in strict adherence to the guidelines of the manufacturers. Improper techniques, such as using too many capsules on a tree, using an incorrect application depth or carelessly inserting or removing capsules can cause damage or inhibit wound closure.

—The author is a professor at the Shade Tree Laboratory, University of Massachusetts; phone 413-545-2402, email at tattar@mi-crobio.umass.edu.

Maximize injection impact

Uptake increases with:

- ▶ soil temperature ($\geq 50^{\circ}\text{F}$)
- ▶ soil moisture (pre- and post-water)
- ▶ wind
- ▶ sunny day

Uptake decreases with:

- ▶ humidity
- ▶ dry soil
- ▶ high air temperatures ($>90^{\circ}\text{F}$) can cause leaf burn