INNOVATIVE IPM APPLICATION TECHNOLOGY

by A. Temple Bowen

I have been intimately involved in developing improved techniques in aerial application of pesticides and feel strongly that there are lessons learned in that area that can help us in arboriculture. I am convinced that 1) application technology, sometimes referred to as dose transfer, is a critical element in the pesticide path from container to pest. 2) The importance of this phase of IPM is becoming even greater as we move toward less toxic materials, as we become subject to greater public scrutiny and the socio-political pressures to avoid non-target placement and effects are regulated to an increasing degree. 3) The opportunities for gains in productivity, efficacy and efficiency are great and can be achieved in the relative short term.

Recently I read an article written by Elizabeth Marshal, referring to IPM as Integrated *Plant* Management. My favorite version of IPM was proposed by Dr. Jack Coster of the University of West Virginia when he coined the term **I**ntelligent **P**est **M**anagement. I define IPM as a planned program to maintain tree (plant) health through the reduction of the effects of insects, diseases, and stress while reducing adverse human health and environmental effects. In my definition, the responsible use of pesticides is a legitimate and often necessary component of IPM.

The term pesticide covers a wide spectrum, from the traditional contact poisons through oils, soaps, synthetic pyrethroids, natural plant substances and *Bacillus thuringiensis* (commonly referred to as *B.t.*). Application technology also is a broad term. Pesticide application includes a wide variety of approaches; root injection, bole (stem) injection, soil application with uptake through root absorption, and foliar application. I have elected to discuss the foliar application of *B.t.* as an example of what has been done over the last 10 years and how I believe we can proceed in the near future to improve our performance with this widely accepted pesticide.

Why should we be interested in improving our application technology? Why is it important to our industry and the success of our IPM programs? A major goal of IPM is to provide enhanced tree care while reducing our use of pesticides. Current information indicates a relatively small fraction of our emitted (sprayed) active ingredient finds its way to the target pest. Depending on a variety of dilution, atomization, canopy architecture and meteorological conditions, estimates of deposit efficiency on or in our target pest range from 10-50% of emitted volume. There is great room for improvement.

Social, political and regulatory pressures (or controls) are all becoming more restrictive. They are aimed at reducing non-target effects and off-target deposits, which, by the way, are not necessarily synonymous.

Improvements in pesticide application technology can, and have, in the aerial experience, attain major objectives of specific and direct benefit to the applicator, the client and society. They are: 1) better efficacy through higher pest mortality, quicker kill and more consistency in results, 2) higher efficiency in terms of using less product and greater productivity per unit of time, both of which impact on lowering costs in increasing unit area treated per unit of time, 3) decreased off-target deposition resulting in greater deposit of active ingredient in the target area,and 4) decreased non-target organism effects on parasites and predators was well as to other mammals, birds and aquatic organisms.

So, what can be achieved? What can we look forward to? I will use the aerial foliar application of *B.t.* as an example. In Canada, the aerial application of *B.t.* for spruce budworm control in large contiguous stands of spruce-fir forests of eastern

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Canada epitomize the potential success of applying improved application techniques of foliar treatments for insect control. As recently as 15 years ago, *B.t.* was being applied in limited areas. Extensive use was limited due to inconsistent results, low productivity and high costs. Applications were of highly diluted spray (4-6 parts water to one part product) and relatively high volumes per unit area (2 gallons/acre or 10 liters/hectare). Currently, *B.t.* is the product of choice because spray technology developments as well as product improvements have now allowed for applications of undiluted product at total volumes of 1/2 pint to 1 quart/acre (0.5-2.3 liters/hectare) a reduction to 8% of previous volumes. Factors such as no mixing, higher potency products and extremely low volumes/unit area have reduced costs close to that of chemical alternatives, while simultaneously providing better and more consistent results.

In the United States, our major *B.t.* target pest is the gypsy moth. Similar improvements are currently underway for this protection program. Our most recent success in reducing damage from coneworms and seed bugs in southern seed orchards provides an even more spectacular example of the potential opportunities. Past practice used the chemical pesticide Guthion at 3 lbs. active ingredient (a.i.) per acre or Pydrin at .75 lbs. a.i.per acre in 5-10 gallons of water per acre. This year an operational program was instituted using 0.6 gallons per acre of undiluted Foray 48B with 5 ounces (16% of the previous volume) of Asana XL. The results are an 84% reduction in chemical a.i., a 94% reduction in volume per acre and a 50% reduction in pesticide cost. It now requires only 150 gallons to treat an orchard that previously required from 1200-2400 gallons of final mix.

Recognizing that forest spraying is significantly different from the urban/suburban circumstances you encounter, how can we achieve these results in our industry? *Motivation* must be a driving force and these exist in forms of lower costs, better and more consistent results and reduced adverse environmental and human health effects. *Organization* for success will depend upon an integrated network of skilled people: biologists, entomologists, arborists, mechanical engineers, chemists, physicists and applicators, manufacturers, end users, customers, government agencies, all working together. *Resources* (money) will also be required.

In my opinion, innovative spray techniques for the ground foliar applications of *B.t.* for caterpillar control in arboriculture have not been forthcoming. Two innovations, of which I am familiar, are just now being initiated into our industry. They both have been in use for several years in pesticide applications for vector control in agriculture and aerial forestry programs.

- Equipment that allows on-site mixing of desired amounts of tank mix can be used. Siphoning equipment introduces the product into the carrier as the carrier is pumped to the nozzle. This is ideal for IPM programs. These systems avoid waste, reduce problems of incompatibility, avoid over-the-road transport of large quantities of pesticide tank mixes, eliminate tank mix shelf life and disposal problems, allow an IPM inspector to treat problems as they are discovered and provide a variety of pesticides to be applied from the same application unit as it proceeds from site to site.
- A new model of Micronair Rotary Atomizer nozzle is now available for use on backpack mistblowers. The Micronair AU-8000 operates on the same "spinning cage" principle as those used on aircraft, only the air rushing out of the mistblower provides the force to spin the cage. The advantages of this system are an easily controlled flow rate, controlled, and narrower droplet spectrum, minimization of waste. It is specifically designed for ULV applications and can handle undiluted *B.t.* flowable concentrates. Out initial tests have indicated that we can achieve droplets of undiluted product down to VMD's approaching 50-75 microns.

What is it that we want this ideal system to minimize?

- Cost, both product and application
- Volume applied, both a.i. and total
- Off target - effects as well as deposit
- Equipment noise level
- Spray cloud visibility
- Anti-feeding effects
- Pest damage/nuisance level
- Handling problems

- Disposal difficulties
- Evaporation
- Offensive odor
- Adverse effects on painted surfaces

What is it that we want to maximize?

- Target insect mortality
- Deposit density and uniformity
- Productivity
- Affected insect life stages
- Application "window"
- Rainfastness
- Shelf life of tank mix

As you can readily see, some objectives are directly contradictory. Examples?

- Rainfastness vs sticking to painted and metal finishes
- Maximum deposit vs anti-feeding effects
- Small droplets enhance deposit on small targets, minimize visibility, and improve canopy penetration, but at the same time they are likely to increase off-target deposition (drift)

The objectives are attainable. We can achieve significant advances. The motivation exists, the skilled people are available. The significant basic data gaps regarding such parameters as atomization, spray cloud behavior, droplet formation, canopy penetration, target impingement and feeding resistance can be filled by the kind of research being conducted by organizations such as the Laboratory for Pest Control Application Technology at Ohio State University at Wooster, Ohio. Through proper networking and availability of sufficient resources, I am confident that at a meeting of the ISA in the relatively near future, someone will be able to come before you and title their presentation "New and Better Foliar Pesticide Application Techniques Currently in Use".

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ABSTRACT

KNOCHE, L. 1990. **High stakes.** Am. Nurseryman 172(6): 90 - 93.

Proper staking and tying are beneficial to trees, while poorly conceived stabilization techniques can weaken or kill them. Frequently, landscape plans do not provide staking instructions, and installation and maintenance contractors are left to improvise. Staking can help young or newly transplanted B&B, boxed or container-grown trees establish strong root systems, thus assuring a higher survival rate. Growers typically bind the trunks of young trees to stakes in the nursery and stake bare-root-planted trees. You should also stake large, transplanted trees that have small soil balls, thus restricting their movement until they are well-established. Trees should be pruned so they are not top heavy. Single-trunk specimens with heavy crowns probably need help also. If the tree is to be single staked, place the stake on the side of the prevailing wind, With double stakes, put one on the windward side and one on the leeward side. Regardless of whether you choose a cinch-tie of twist-brace devise, the trunk must have room to expand. Two or three years after installation, detach the ties or braces, and try to move the tree in the soil. Any resulting gap between the tree trunk and the soil is reason for concern.