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Improving pesticide use in nurseries and greenhouses

by DR. FRANK BYRNE

In most cases, pesticides are necessary if we want to guarantee high-quality ornamental crops for our customers. We all support greener, more environmentally friendly approaches to protecting our plants from bugs. In fact, many producers would gladly forgo the use of pesticides if methods were available that provided effective and economically viable solutions to pest-control problems. The truth, though, is that biological control isn't always able to do the job on its own, and a little help from pesticides is often required. Think back a few months to when you bought your Christmas poinsettias and proudly displayed them for purchase during the festive season. They were completely free of damage. A lot of work went into producing those plants, including painstaking efforts at keeping them free of insect pests.

Not too long ago, growers relied upon broad-spectrum pesticides to deal with many different pests. The consequences of relying on these types of products are widespread resistance in pests, such as whiteflies and aphids, and serious disruption to biological-control programs. Indeed, natural enemies are often more susceptible to pesticides than the intended target insects because of their inherently weaker defenses. We have now entered a new age with regard to pesticide use. With the introduction of several novel insecticides, growers can now select products that are more specific for their pest-management needs, without having to worry about nontarget effects that were the bane of broad-spectrum products.

ELISA plate test

One group of insecticides that is widely used within the nursery and greenhouse industries is the neonicotinoid class. These insecticides have a greater selectivity against insects and avoid many of the environmental and human health issues associated with older, broad-spectrum chemicals.

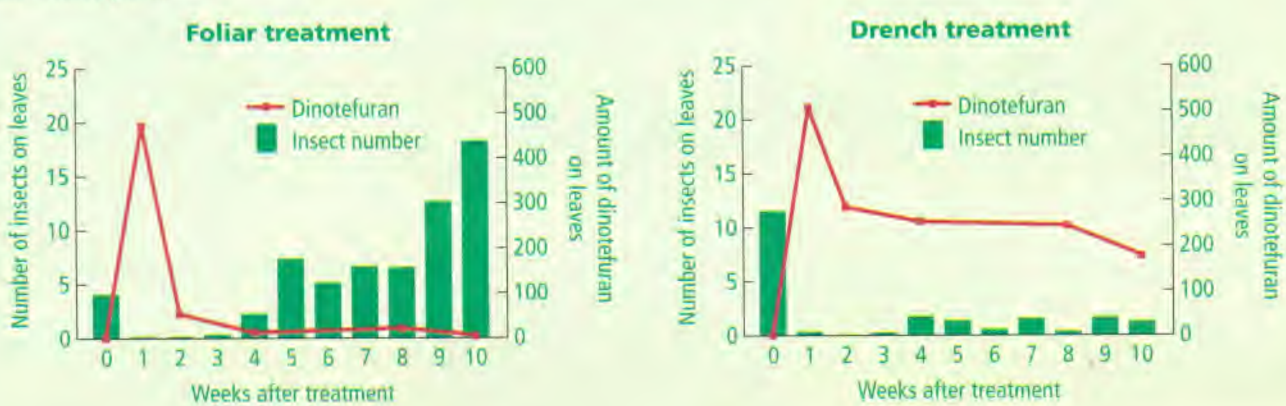
New technologies. New technologies allow us to improve pesticide use in our greenhouses. The more information we can gather about the behavior of insecticides in our nurseries and greenhouses, the better we can exploit them to achieve our pest-management goals. Research being conducted at the University of California, Riverside, is helping us better understand how pesticides work. As part of the department of entomology, I am working with several university and industry scientists in an effort to figure out how neonicotinoids control major pests.

Conventional assessments of pesticide efficacy against arthropod pests routinely rely upon measurements of pest mortality in a series of bioassays, which are conducted at regular intervals following insecticide treatments that use foliage sampled from the treated plant. An additional approach is to monitor the development and growth of a population over time following an artificial infestation just prior to the treatments. While both approaches provide essential information on the residual efficacy of the insecticide treatments, neither approach provides any information on the threshold levels of insecticide needed to kill the target pest.

If we know how much insecticide is needed to kill an insect, then we can tailor our treatment rates and application methods to meet those requirements, bearing in mind that there are regulations on the amount of insecticide that we can use. Not

Measuring insecticide levels in plant tissue

ELISA was used to measure the levels of dinotefuran (red lines) on and in poinsettia leaves treated with the insecticide Safari. The blue bars show the number of whiteflies on the plants at the different levels of insecticide. Both treatments kill insects that are on the plants at the time of the treatments. The greater persistence of the drench treatment ensures that the populations do not recover to the same extent as on foliar-treated plants.



I use a technique, known as enzyme-linked immunosorbent assay, to measure insecticide residues in plants that have been treated with either foliar or drench applications of neonicotinoids.

only would this information allow us to optimize the use of an insecticide, but it also, perhaps more importantly, would enable us to avoid using a product that was not suitable for a particular situation.

I use a technique, known as ELISA, to measure insecticide residues in plants that have been treated with either foliar or drench applications of neonicotinoids. ELISA stands for enzyme-linked immunosorbent assay and is used mainly in immunology, in which antibodies detect the presence of an antigen in a sample. Antibodies can be raised against a specific pesticide and then used to quantify that pesticide in samples of groundwater or plant tissue.

ELISAs are now commercially available for several neonicotinoids, and I use them to measure insecticide levels in plant tissues. By doing so, I can compare insect survivorship and population development on a plant with the levels of insecticide that were present within the plant. It's a really valuable research tool. At the university, we have learned so much more about neonicotinoids since we started using ELISAs in our research.

ELISA kits are extremely sensitive and can detect insecticide concentrations even lower than 1 part per billion. To use the kit, a sample of plant tissue is weighed and then ground up in water or another suitable solvent. A portion of these extracts is then used for the assay, and within two hours, we know how much insecticide is present in the sample. Each kit can analyze up to 96 reactions, so you can get a lot of information from just one kit.

Research using ELISA. Take a recent study that I did in collaboration with professor Ron Oetting of the University of Georgia, Athens, and Dr. Joe Chamberlin of Valent USA Corp., Snellville, GA. In that study, we monitored the buildup of whiteflies on poinsettias that were treated with either foliar or drench treatments of the insecticide Safari. The active ingredient in Safari is dinotefuran — a new neonicotinoid insecticide that is also being increasingly used for pest management in nursery and landscape plants. When it is applied to the soil as a drench treatment, the dinotefuran is taken up through the roots for distribution throughout the whole plant. We are learning a lot from our greenhouse studies that will enable us to implement the use of these important insecticides more effectively in nurseries and landscape systems.

In the greenhouse study, Oetting monitored the whitefly numbers on the plants for up to 10 weeks after he treated them and sent leaf samples for ELISA analysis to me. When I compared the insect numbers with the insecticide residue levels either in or on the leaves of the plants, I was immediately able to understand what was going on. The ELISA data showed that both the foliar and drench treatments were very effective at knocking down the resident adult population of whiteflies present on the plants. The ELISA data also showed us how quickly the dinotefuran got into the plants after the drench application. We were able to measure the persistence of the dinotefuran under both modes of application. Clearly, the drench treatment was very persistent and was able to suppress the insect population for up to three generations.

I am already exploiting the technology to look at other plant systems and their pests. These include emerald ash borer, hemlock wooly adelgid and boxwood leafminer. Pesticides will continue to play a major role in the management of ornamental pests in the greenhouse, nursery and landscape. Any technique that helps us to learn more about how they are working in our plants has got to be a good one.

Dr. Frank Byrne is an assistant researcher in the department of entomology at the University of California, Riverside. He can be reached at frank.byrne@ucr.edu.