



Home gardeners have used plant spikes for many years but only recently have they been made available for commercial nurseries. Experimental spikes reduced infestations of Cuban laurel thrips in ficus (above) and of honeylocust pod gall midge (right) but not to a commercially acceptable level.

of the compounds themselves (the spikes carry a warning label, and the applicator needs to wear gloves); (2) they dissolve slowly, so the material would be available to the plant for a longer time and with less leaching out of pots when compared with systemics applied as a granular formulation; (3) fertilizer and insecticide are delivered to the plant simultaneously; (4) plant roots eventually grow into the spike and take up the insecticide directly, so that soil type should be less of a factor in insecticide performance; and (5) precise concentrations can be delivered to individual pots.

Efficacy trials

Two insects of serious concern to nursery growers in California are the honeylocust pod gall midge, *Dasineura gleditschiae* (O.S.), which attacks honeylocust, *Gleditsia triacanthos* L., and the Cuban laurel thrips, *Gynaikothrips ficorum* (Marchal), which attacks Indian laurel, *Ficus retusa* L. Both insects have multiple generations per year and attack young terminal growth. Although they will not kill a tree, their feeding causes galls and severe leaf twisting, which greatly reduces aesthetic value. It is this behavior that reduces the effectiveness of foliar-applied sprays and increases the need for frequent applications. We decided to test systemic insecticides for their ability to protect young foliage over a long period.

Cuban laurel thrips

When the trial began, all plants were lightly infested. We removed previously damaged leaves from trees in the trial so that all treatments would be equal at the start. Twenty Indian laurel trees, about 5 feet tall, in 5-gallon pots, were arranged in a randomized block design with four single-tree replicates of each of five treatments.

Treatments consisted of three systemic insecticides—Standak, Furadan, and Di-Syston—incorporated into 50-gram spikes (1 percent active ingredient), a fertilizer spike (no insecticide) control, and an untreated control. Pots were treated

Plant spikes for commercial nurseries

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Since the development of systemic insecticides in the 1940s, growers of ornamental and agricultural crops have used them extensively for insect and mite control. Soil-applied systemic insecticides have several advantages: (1) applications are generally more efficient than foliar-applied sprays (systemic materials are translocated internally by the plant); (2) residual control is usually longer than with sprays that are prone to weathering on exposed leaf surfaces; (3) young growth, appearing after application, is protected; and (4) application and residues of these materials are usually less hazardous to beneficial species.

Systemic materials also have disadvantages. They are effective primarily against sucking insects (aphids, mites, thrips, and the like), although there are exceptions (they control some stem- and leaf-feeding insects but not some bark-feeding [sucking] scale insects). Questions continually arise concerning the toxicity, prolonged soil residues, and leaching from application sites when systemic materials are applied to the soil. These reasons and others have been responsible for the removal of some systemics from the

market (for example, Systox [demeton] and increasing regulations have been imposed or are being considered for products with registration [Metasystox-R, Temik [oxydemeton-methyl]). The incorporation of selected insecticides into plant spikes may reduce some of the problems associated with systemics.

Plant spikes

Plant spikes, with fertilizer only or with fertilizer plus pesticide, have been available to homeowners for many years but only recently have been developed for commercial nurseries. Plant spikes are produced for experimentation in three sizes (6, 50, and 150 grams) for use in different pot sizes. Three systemic insecticides, Di-Syston, (disulfoton), Standak (aldoxycarb), and Furadan (carbofuran), have been incorporated so that each spike contains only 1 percent active ingredient. Various concentrations of fertilizer (nitrogen, phosphorus, and potassium) are also available to provide the needs of different plant species.

These plant spikes have several potential advantages: (1) they have low toxicity to the applicator despite the high toxicity

TABLE 1. Effect of systemic insecticides on first-generation honeylocust pod gall midge infesting older terminals

Treatment*	Mean no. galls/ terminal	Mean no. larvae/5 galls†	
		Live	Dead
Fertilizer control	5.7 a	2.0 a	0.2 a
Water control	5.6 a	0.4 b	0.2 a
Furadan	4.5 ab	1.5 ab	0.1 a
Di-Syston	4.2 ab	0.4 b	0.1 a
Standak	2.5 b	0.3 b	0.1 a

* 150 g of total spikes per 15-gal container; 20 trees/treatment; 5 replicates/block, 4 blocks.
 † Means of 3 old terminals/tree. Means in the same column followed by the same letter do not differ significantly ($P < 0.05$), Duncan's new multiple range test.

TABLE 2. Effect of selected systemic insecticides on second-generation honeylocust pod gall midge infesting young terminals

Treatment*	Infestation level†	Mean no. larvae/5 galls‡	
		Live	Dead
Water control	2.1 a	8.8 a	0.15 b
Furadan	2.1 a	7.6 a	0.07 b
Fertilizer control	2.0 a	8.6 a	0.02 b
Di-Syston	1.9 a	8.3 a	0.03 b
Standak	1.5 b	3.3 b	0.80 a

* 150 g of total spikes per 15-gal container; 20 trees/treatment; 5 replicates/block, 4 blocks.
 † Rating for number of galls/young terminal with 3 terminals/tree: 3 = heavy (>500 galls); 2 = moderate (100-500 galls); 1 = light (<100 galls). Means in the same column followed by the same letter do not differ significantly ($P < 0.05$), Duncan's new multiple range test.
 ‡ Means of 3 young terminals/tree. Means in the same column followed by the same letter do not differ significantly ($P < 0.05$), Duncan's new multiple range test.

with two spikes each (100 grams total) buried below the soil surface. All treatments had 16-4-4 fertilizer formulations except the Di-Syston, which had 15-3-3.

Plants were cleaned and treated on July 26, 1985. Before the spikes were applied, plants received foliar sprays of Metasystox-R on May 3, June 7, and June 19 for Cuban laurel thrips control. Tree care was according to the normal grower practice. To assess the effect on the thrips, we counted the number of newly infested leaves every week, including leaves with feeding damage only (discolored) and those that were distorted or curled. At the end of four weeks, we analyzed the data statistically (using ANOVA).

For the first three weeks, treated plants did not differ from the controls. By the fourth week, Furadan and Standak significantly ($P < .05$) reduced the number of damaged leaves when compared with the fertilizer controls.

At the end of the trial, insect pressure in the area was increasing and surrounding trees were heavily infested. Infestation of trial trees was also increasing, perhaps because of reduced effectiveness of the spikes, which had been in place for five weeks. The water-only controls were chlorotic due to lack of fertilizer, which seemed to make them less attractive to the thrips. Location of the trees also affected the level of infestation; all treatments in the two rows nearest a brick wall were noticeably less infested than the outer two rows.

Honeylocust pod gall midge

Three-year-old honeylocust trees, about 9 feet tall in 15-gallon pots, were arranged in a randomized block design with five single-tree replicates per treatment in four blocks (20 trees per treatment). Treatments were the same as for Cuban laurel thrips. All spikes consisted of 1 percent insecticide active ingredient with a 100- and 50-gram spike used in each pot (150 grams total).

Spikes were added to the pots (buried at least 1 inch below the soil line) on April

19, when no galls were visible on the trees. Adults of the first-generation honeylocust pod gall midge, however, were emerging and laying eggs. Tree care was left to the grower; each tree was hand-watered every two or three days, depending on weather conditions.

Evaluation of the insecticides about 3½ weeks later (May 13) was confounded by emergence and egg-laying of the second summer generation (about the first week in May). To assess the effect of the insecticides on the first summer generation, we selected three older terminals (8 inches from the growing tip) from each tree. We evaluated the second generation by selecting three young terminals (feather growth) at the growing tip of each tree. In all cases, terminals were selected at random from the growing points of the tree, placed in plastic bags, and transported back to the laboratory in a cooler.

We counted the total number of galls on the older terminals, then randomly selected five galls from each terminal and noted the number and condition of the larvae in each gall. The younger terminals had such heavy infestations that it was impossible to count all the galls. We therefore devised a rating system to quantify the intensity of the infestation. Five galls randomly selected from each young terminal were dissected and inspected, as just described.

The effect of all treatments against first-generation honeylocust pod gall midge was minimal; only Standak significantly reduced the number of galls per terminal when compared with the controls (table 1). No differences were noted among treatments when the condition of larvae in galls was examined. The small effect observed with first-generation midges is not surprising, since they were laying eggs the day the spikes were applied; it is unlikely that the insecticides could be translocated to the growing tips in time to prevent gall formation or to affect larvae.

Effects on the second generation were far more striking. Standak significantly

reduced the infestation level, and also reduced the number of live larvae and increased the number of dead larvae when compared with the other treatments (table 2).

Conclusions

While the spikes reduced the infestation levels of Cuban laurel thrips and honeylocust pod gall midge, greater control is necessary for this treatment to be acceptable in commercial nurseries. Also, control in both trials seemed to diminish after four weeks. It had been anticipated that efficacy would last longer, significantly affecting the economic feasibility of the spikes.

No problems with phytotoxicity occurred on honeylocust or Indian laurel. Concurrent trials with potted chrysanthemum and Monterey pine, however, demonstrated that phytotoxicity could be serious on those plants. In most cases, the fertilizer was responsible.

New spikes have been developed with increased insecticide concentration (2 to 3 percent) and lowered fertilizer content (3 percent) in an attempt to improve efficacy and reduce phytotoxicity. Trials have shown that these are safe to use on potted chrysanthemum, but efficacy tests have not been conducted. Although registration of these spikes has been approved at the federal level, they are not presently registered for this use in California.

In light of increasing regulations and restrictions on the use of soil-applied systemic insecticides, the spikes have great potential. However, more research is needed on efficacy and phytotoxicity on a broad range of insects and host plants. Also, the utility of these spikes in the landscape, where they are placed directly into the ground, must be evaluated.

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