

LANDSCAPE PEST MONITORING METHODS AND TRAINING MANAGERS TO USE THEM

by Steve H. Dreistadt and Mary Louise Flint

Abstract. Monitoring is the systematic collection and recording of information on pests and damage. Scale insects and aphids, respectively, can be efficiently monitored using sticky tape traps and water sensitive paper. We describe these monitoring techniques, present examples of their use in controlling citricola scale infesting Chinese hackberry and painted maple aphid infesting silver maple, and discuss our methods of training landscape pest managers to monitor.

Monitoring is one cornerstone of integrated pest management. Monitoring is the routine (e.g., weekly or biweekly) inspection of plants for pests and damage or systematic use of specialized monitoring tools. Monitoring results are kept as written records and evaluated over time to make more effective pest management decisions. Although many arborists visually inspect trees for pests and damage (10), we find very few that use other systematic, research-based monitoring techniques and decision-making guides. More effort must be directed toward developing practical methods, demonstrating the benefits of monitoring, and training arborists and landscape managers to use monitoring methods.

Over the past few years, we have been working on better methods for disseminating pest monitoring information. In this paper, we briefly describe monitoring methods for the two most important urban forest pests—aphids and scales (7)—and discuss our hands-on training efforts to encourage managers to incorporate monitoring into their decision-making process.

Scale Insects

Scales are common and damaging pests that are easily overlooked because they are small, immobile during most life stages, and do not resemble most other insects (Figure 1). Scales are a problem in landscapes when they cause dieback or aesthetic damage such as honeydew

that is intolerable. Many scales can be controlled either by applying oil during the dormant season or a narrow-range oil or another insecticide when foliage is present (2). Treatment during the foliar season is common because that's when most people notice scales and want them controlled, but spring and summer treatments are often ineffective due to poor timing of control actions. Although mature scales are more obvious, they are not easily controlled. For most effective control during the foliar season, sprays must be directed at the youngest stage nymphs or first instars, called crawlers when they are newly emerged and still mobile. Because crawlers are

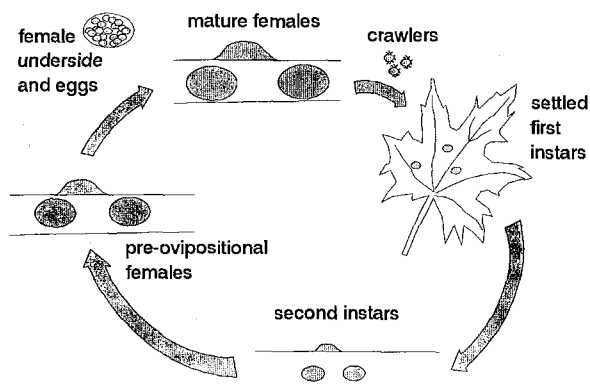


Figure 1. Life cycle of a typical soft scale insect (family Coccidae). This species moves between bark and foliage, some scale species occur only on bark. Most species of soft scales have only one generation each year, armored scales (family Diaspididae) typically have several generations a year.

tiny and abundant for only a short time, it's unlikely they will be controlled without systematic monitoring to determine when to treat.

A tool for monitoring scale crawlers is double-sided transparent tape, available in any stationery store. To make traps, a twig or small branch is tightly encircled with a strip of tape about 5 inches long. The free end of each sticky band is doubled over to make a handle to easily unwind it (Figure 2). Newly hatched scale crawlers get stuck in tape traps as they walk along twigs or branches in search of sites to settle down and feed. Crawlers appear as yellow or orange specks when sticky traps are unwrapped; managers can confirm that they are scales rather than debris by examining traps with a hand lens.

Traps must be deployed, two or three to a tree, before crawlers are expected. Put out traps when mature females are detected, commonly in the spring. If you're uncertain of the scale's life cycle, have the scales identified and obtain life cycle information from a reliable source, such as a cooperative extension office or university publication (4,6). Once deployed, change tapes once a

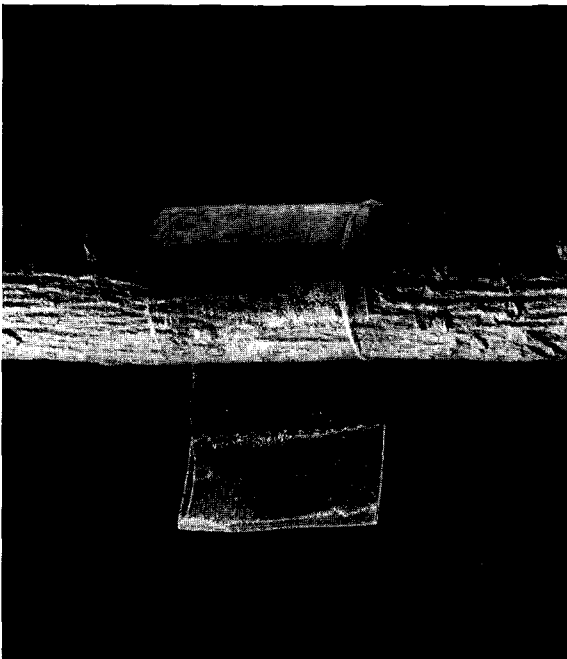


Figure 2. Sticky tape wrapped around a twig to monitor scale crawlers.

week, placing a new tape trap at the same spot. Tie a tag or flagging near each trap to help relocate it when you come to replace it the following week. Preserve the old traps between a sheet of white paper and clear plastic, labeled with the date and location. Visually compare traps from each monitoring date. If treatment is warranted, apply oil or another insecticide at or soon after the peak in crawler emergence or after a sharp increase in crawler numbers is observed in traps. It is important to note that this monitoring technique tells you when to spray for most effective results—not whether treatments are needed. Use tree damage or the abundance of mature scales to determine if treatment is needed.

Sticky tape traps have been used for many pests, including California red scale (13), irregular pine scale and Kuno scale (8), San Jose scale (12), and sycamore scale (11). A single application of 2% superior oil (SunSpray Ultra-Fine) applied around peak crawler density (Figure 3) was just as effective as implanting trunks with acephate (Acecaps containing Orthene) used to control citricola scale (*Coccus pseudomagnoliarum*) infesting Chinese hackberry (*Celtis sinensis*) on the University of California, Davis, campus in 1991 (Figure 4). It took one person one hour a week during spring to collect and replace two traps per tree on each of 11 trees; about one half this number of traps is probably sufficient in most situations.

Street Tree Aphids

Aphids are a problem on woody landscape plants primarily because of the sticky honeydew aphids produce and the resulting sooty mold growth. Like many cities, Modesto, California, uses systemic insecticides to control aphids. For many years this involved injecting susceptible trees once each spring with dicotophos (Bidrin). When the manufacturer withdrew Bidrin from the market in 1992, the City of Modesto switched to acephate implants, but with disappointing results. Silver maples (*Acer saccharum*) implanted during summer were dripping with honeydew by fall. The unsatisfactory control of painted maple aphid (*Drepanaphis acerifoliae*) was apparently due to the insecticide's relatively short persistence and

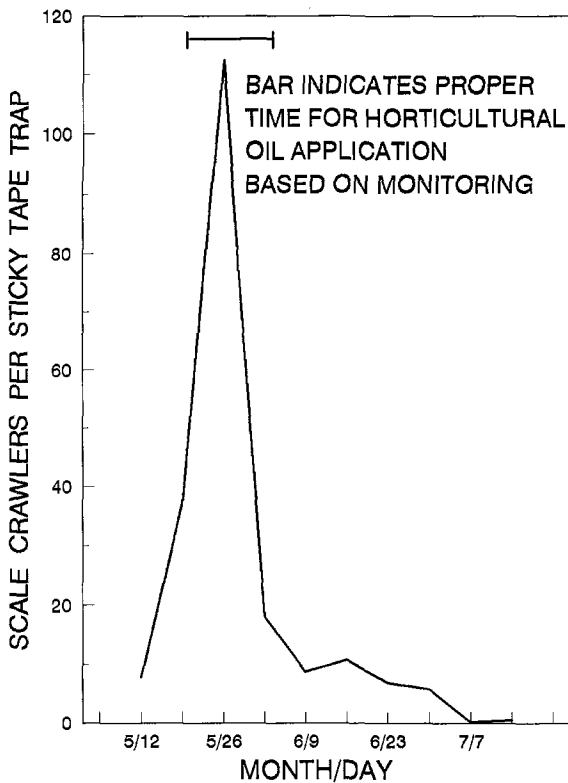


Figure 3. Scale crawler density monitored on five untreated Chinese hackberry trees in Davis, California, during 1991. Two traps per tree were used, each replaced weekly and encircling a twig 9 mm (SD = 2) in diameter. A single application of horticultural oil was made (May 28) on a nearby group of ten trees.

poor application timing. However, previous efforts to time treatments by clipping terminals and inspecting them for aphids proved unsatisfactory. The aphids are tiny and the maples are huge. Aphids seemed to increase dramatically over a short time, quickly fouling parked cars and pavement with sticky honeydew. The difficulty in effectively timing application was a major reason why the City originally used Bidrin, which seemed to provide season-long control, without need to precisely time application.

City Arborist Allen Lagarbo sought help for this aphid problem from Ed Perry, a University of California Cooperative Extension Advisor in Stanislaus County. Perry suggested timing applications by monitoring damage (honeydew pro-

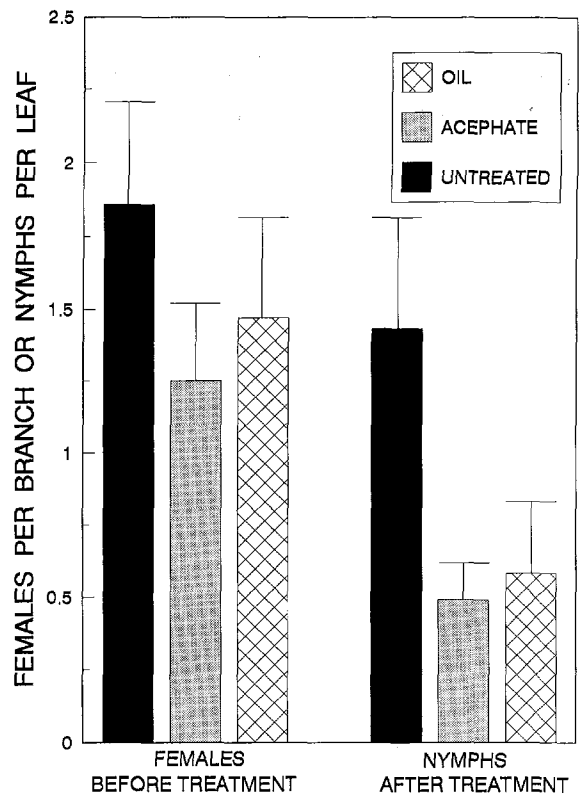


Figure 4. Average (+ SEM) density of female citricola scales per 30-cm long branch before treatment and scale nymphs per leaf on Chinese hackberry after one treatment with acephate implants (on May 20-24) or foliar application of 2% oil (May 28) in Davis, California, during 1991. Female scale densities are not significantly different between treatments and controls ($P > 0.05$, t tests). Nymph densities after treatment are significantly lower ($P < 0.05$, Dunnett's one-tailed t tests) on oil or acephate treated trees in comparison with untreated trees. Five untreated trees and three trees receiving each treatment were sampled on each date. Samples were eight terminals per tree collected on each of three dates during May before application and 20 leaves per tree collected on each of two dates (July and August) after treatment.

duction), rather than inspecting trees for aphids. This monitoring method was developed in Berkeley for both timing applications and establishing thresholds to determine if treatment was needed (5). Beginning in summer, 1993, Perry and Lagarbo monitored honeydew using water sensitive cards; honeydew makes a dark blue dot wherever it

lands on the card's bright yellow surface (3). Once each week, they placed four cards (one in each cardinal direction) under each of several trees. Cards were taped to cardboard attached to a bent wire coat hanger. A telescoping pole pruner with a hook at the end was used to hang each card about 18" beneath foliage on each lower, outer canopy limb (Figure 5).

Perry and Lagarbo put out honeydew cards for four hours each week, then retrieved the cards and examined them for droplets. Unlike other species that are common in spring, aphids infesting Modesto's silver maples didn't produce honeydew in quantity until late August. By delaying control until monitoring revealed substantial honeydew (about 1-2 drops/cm²/4 hours), Modesto achieved satisfactory control using implants and received no complaints about honeydew from the public. Post treatment monitoring showed a dramatic decline and near elimination of honeydew production within a week after control, except on untreated maples.



Figure 5. Aphid honeydew monitoring card hung beneath a tulip tree branch.

Providing Written Resources

Pest managers must be provided with adequate information and training or they will not use even available monitoring techniques. Although both the monitoring methods for scales and aphids had been described in technical journals, they were not generally available in "how-to" type publications readily accessible to landscape pest managers. One major goal of the University of California Statewide Integrated Pest Management Project is to make practical information available to managers. The recent publication of *Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide* (4) fills a gap in information by describing and illustrating available monitoring methods for dozens of landscape pests. This comprehensive book also covers identification, biology, and management of common insect, disease, weed, and cultural care problems of woody landscape plants. Insect and mite monitoring methods discussed and pictured in the book are listed in Table 1. Disease and weed monitoring as well as methods like landscape maps applicable to a variety of problems are also covered in the book.

Learning First Hand

While good published information is essential, it must be complemented with effective training and demonstration activities. Learning is more successful when there is active involvement; experience is the best teacher. In a shift away from lecture hall presentations, the University of California's Statewide Integrated Pest Management Project has begun sponsoring hands-on training seminars where landscape professionals learn by actually using the recommended techniques. Seminar attendees are placed in small groups, which spend the day rotating among various practice and demonstration sessions.

To learn scale monitoring, participants are provided with a set of twigs, each with a sticky tape trap labeled with a different date. Traps contain a range of crawler numbers, representing population levels to be expected from monitoring infested plants over time during the spring. Participants unwrap, preserve, and inspect one trap from each date and estimate the density of crawlers each

Table 1. Insect and mite monitoring methods.**Methods**

Invertebrate species

Visual inspection of plant parts

Most exposed-feeding species, including evidence of parasitism and predation. Monitoring tiny pests requires a hand lens

Branch beating

Most exposed, readily dislodged species, especially the adults, including leaf beetles, mites, thrips, psyllids, true bugs, leafhoppers, weevils, non-webbing caterpillars, lady beetles, green and brown lacewings

Sticky traps

Adult whiteflies, thrips, leafhoppers, psyllids, fungus gnats, *Liriomyza* spp. leafminers, winged aphids, parasitoids*

Double-sided sticky tape

Scale crawlers

Burlap trunk bands

Adult weevils, gypsy moth larvae

Pheromone traps

Adults of certain moths and scales, including clearwing moths, fruittree leafroller, omnivorous looper, Nantucket pine tip moth, gypsy moth, San Jose scale, California red scale

Pitfall traps

Adult weevils, predaceous ground beetles

Timed counts

Pest individuals that are relatively large and obvious, such as caterpillars, and occur at relatively low density so they are not observed faster than they can be counted

Honeydew monitoring

Aphids

Frass droppings

Non-webbing caterpillars

Degree-day monitoring

Species for which researchers have determined thresholds and rates, including elm leaf beetle, Nantucket pine tip moth, California red scale, San Jose scale

Reprinted from *Pests of Landscape Trees and Shrubs*, Publication 3359. Available for \$32 from DANR Publications, University of California, 6701 San Pablo Avenue, Oakland, CA 94608-1239. Telephone 510-642-2431 or toll free in California only: 800-994-8849.

contains. They share trap data with other persons in their group to obtain multiple samples for each date, calculate the average number of crawlers per trap, then decide when to treat based on these data. Participants also practice deploying traps (wrapping twigs with tape) and learn how to use a hand lens to recognize live scales of different life stages and species.

Honeydew monitoring is taught by providing trainees with cards containing droplets like those

from monitoring aphids on different dates. Participants estimate the droplet density on each card by visual comparison with prepared standards. They graph the data from each week to develop a record of the seasonal pattern of aphid honeydew density. Monitoring is demonstrated by placing water sensitive cards under aphid-infested potted plants, which serve as simulated trees.

During each day-long hands-on course, instructors conduct the same training session about 5-8 times, each time with a different small group. The trainers, mostly University research and extension personnel, get immediate and plentiful feedback; pest managers share their experiences and observations, stimulating University workers to investigate and adapt methods so they become more efficient and useful in the real world. For example, when employing sticky traps to monitor crawlers, researchers quantify seasonal changes in scale density by counting each insect. However, pest managers are only interested in a single event, the peak in crawler production that tells them when it's time to treat. By collecting and preserving traps so that they can be readily examined, pest managers need only make a quick visual comparison among traps from different dates to observe when a dramatic and obvious increase in insects occurs. This modification avoids the tedious and time consuming counting of many tiny scale crawlers and adapts a research monitoring tool to efficient use for decision-making by pest managers.

Landscapes should be routinely inspected for proper cultural care, damage, and pest problems. Monitoring identifies when, where, and how extensively any problems occur (1,9,10). Monitoring helps managers to determine the causes of problems, determine if control action is needed, and when and where to take action. Monitoring allows managers to evaluate whether their efforts have been effective or may need to be modified. Time invested in monitoring can avoid plant damage, reduce the extent and expense of any necessary management actions, and improve control effectiveness. Regular monitoring detects developing problems early, allowing use of more selective or slower acting methods that may be less environmentally disruptive. Many useful

methods are available. We must be more creative and effective in our approach to delivering monitoring information to landscape pest managers.

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Résumé. Les cochenilles et les pucerons peuvent être efficacement suivis en utilisant des pièges faits de bandes adhésives et des papiers sensibles à l'eau. On y décrit ces différentes techniques de suivis et présente des exemples de leur emploi pour contrôler l'infestation du micocoulier chinois par la cochenille citricole ainsi que l'infestation de l'érable argenté par le puceron de l'érable.

Zusammenfassung. Schildläuse und Blattläuse können durch die Anwendung von klebrigen Fallen und wasserempfindlichen Papier ausreichend überwacht werden. Wir beschreiben diese Überwachungsmethoden, geben Beispiele für ihre Anwendung bei der Kontrolle von Zitricola-Schildläusen, die Zürgelbäume befallen, und dei Ahornblattläusen auf Silberahorn.