



Sticky Trap Monitoring of Insect Pests

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Sticky traps are an efficient tool for monitoring adults of many pests, including leafminers, thrips, and whiteflies. This publication is a practical guide to using traps properly, recording and interpreting catches, and developing control action thresholds. Although this information is intended primarily for commercial greenhouse growers, pest managers of outdoor nurseries, field crops, and orchards will also find it to be useful.

WHY TRAPS ARE USEFUL

Trap catches can warn of pest presence, hot spots, and insect migration and activity and can also provide a relative measure of insect density. Comparisons of the number of adult pests caught on sequential sampling dates may indicate whether the pest density in crops is changing or remaining relatively constant over the long term (Gillespie and Quiring 1987; Higgins 1992). Evaluating trap catches can help in determining the need for treatment, the timing of applications, and the effectiveness of previous control actions. By grouping two or more traps together near doorways, vents, and inside and outside of growing areas, growers can determine the direction from which insects are migrating by orienting each trap a different direction and comparing the relative number of pests caught on trap surfaces facing different directions.

Sticky traps alone are generally not a good tool for directly determining the need or timing of treatment applications. Traps must often be used in combination with visual inspection of plants and other scouting methods to be effective (table 1; fig. 1). In cases where immature stages of a pest cause the most damage to crops, adult trapping may not a reliable indicator of damaging levels of pests. Even so, traps are often a very efficient and important monitoring tool, alerting growers to the presence of pests before damage can be observed.

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USING TRAPS

Unless other guidelines are recommended, use about 1 sticky trap per 10,000 ft² (930 m²) of greenhouse growing area. When monitoring whiteflies, use about 1 trap per 1,000 ft² (93 m²) of growing area. Outdoors, a lower density of traps is commonly used. Additional traps can be placed at field edges and inside greenhouse doors and vents to monitor for pests migrating into crops. Actual trap location and density will be dictated by the growing area and the time and effort devoted to trapping.

For most crops, use bright yellow traps that are 3 by 5 inches (7.5 by 12.5 cm) or larger. If western flower thrips is the primary species of concern, consider using blue sticky traps. Orienting traps horizontally (facing the soil) is sometimes recommended when monitoring pests such

as fungus gnats emerging from media. However, in most monitoring programs, to catch the most insects, orient the longest part of the trap vertically (up and down) (see fig. 2). Place each trap so that the trap's bottom is even with the top of the plant canopy. For rapidly growing crops, locate the trap's bottom a few inches above the canopy so that plants don't overgrow the traps. As plants grow, move each trap up so that the bottom remains about even with the top of the canopy. Upward adjustment of trap height can be done each time traps are inspected.

Count the number of each type of pest caught. Record these data on a form such as the one in figure 4. It is not necessary to count all insects on the entire trap; counting the insects in a vertical column that is 1 inch (2.5 cm) wide on both sides of the trap will give results that represent the entire trap (Heinz, Parrella, and Newman 1992)

Table 1. Invertebrate monitoring methods

Method	Insects monitored
Visual inspection of crop or growing area	Most exposed-feeding species and their damage. Look for evidence of parasitism and predation (monitoring may require a hand lens or other magnifier).
Sticky traps	Adults, including fungus gnats, leafminers, psyllids, shore flies, thrips, whiteflies, winged aphids, and parasites.
Shaking plants, branch beating, or tapping containers over a collecting surface such as a clipboard with a white sheet of paper	Adults and larvae or nymphs of easily dislodged species, including bugs, lacewings, lady beetles, leaf beetles, leafhoppers, mites, nonwebbing caterpillars, psyllids, thrips, and adult parasites and whiteflies.
Carbon dioxide exhalation and shaking	Thrips hidden in buds, which are stimulated to move by a long, gentle breath into terminals; shaking plant tips over white paper on a clipboard dislodges and reveals the thrips.
Indicator or sentinel plants	Most exposed-feeding species and their damage. The same infested plants should be inspected before and after any treatment to determine whether pests are in the stage(s) susceptible to planned control actions, to compare numbers to previous sampling, and to determine the effectiveness of control actions.
Pheromone-baited traps	Many moths, certain beetles, and males of some scale insects. Certain parasite adults are attracted to their host's pheromone.
Black light or visible light traps	Night-flying adults of moths, some beetles (e.g., chafers, white grubs, other scarabs, and some leaf beetles), lacewings, and some others.
Degree-day monitoring	Many pests and some beneficial species for which temperature development thresholds and rates have been determined.
Soil drench or flushes using pyrethrum, soap, or in some situations plain water	Relatively mobile species in soil or other hidden places, including centipedes, millipedes, symphylans, and larvae of fungus gnats and shore flies. Thrips and possibly other species in buds may also be flushed out with pyrethrum.
Pitfall traps with or without a bait attractant	Adult weevils, predaceous ground beetles, ground-dwelling spiders, and possibly some others such as squash bugs.
Trap boards	Adult weevils, snails, and slugs.
Potato traps	Root-feeding fungus gnat larvae, which migrate to feed on the underside of potato pieces. Use 1-inch (2.5 cm) cubes or disks of raw potato imbedded about 1/2 inch (12.5 mm) deep into container media. Pick up and examine for larvae on the underside of each disk and on the soil surface immediately beneath the disk once or twice a week.
Timed counts	Individuals of exposed beneficial and pest species (e.g., lady beetles, caterpillars) or certain types of damage (rolled leaves) that are relatively large and obvious but occur at relatively low density so they are not observed faster than they can be counted.
Host collection and rearing	Immature stages of species that feed inside their parasitized host insect or plant. Many insects can be positively identified to species only in the adult stage.



Figure 1. Diagnosing and monitoring problems caused by tiny pests requires a hand lens or other magnifier. A hands-free magnifier, such as this one mounted on an adjustable headband, can be helpful.

(fig. 3). Do not, however, reduce traps to 1-inch vertical strips, as smaller traps may be less attractive to insects.

Since many insects in traps may be harmless or beneficial, it is important to carefully identify insects before taking control action (plates 1–6; fig. 5). You can preserve used traps by wrapping them in clear plastic wrap and then take them to a Cooperative Extension or a county agricultural department expert for help with identification.

Number each trap and map its location in your growing area. Inspect each trap at regular intervals, usually once or twice a week. Some pests have a daily pattern of activity; for example, greenhouse whitefly (*Trialeurodes vaporariorum*) and silverleaf whitefly (*Bemisia argentifolii*) infesting greenhouse gerbera and poinsettia were caught mostly between about 9 AM and 1 PM (Liu, Oetting, and Buntin 1994). Inspect traps at about the same time of day to make results comparable among dates. It is easiest to replace traps each time you inspect them. Traps can be wrapped in clear plastic and taken to a comfortable location for counting later that day. Alternatively, replace traps when they become too fouled to count insects quickly. If traps are reused, catches become cumulative, and you must subtract all previous catches in order to determine the number of insects caught during the most recent period.



Figure 2. Orient each trap vertically and place the bottom of the trap even with the top of the plant canopy. As plants grow, move each trap up so that the trap bottom remains about even with the top of the canopy. Two clothespins glued together facing opposite directions and attached to a bamboo post or wood dowel embedded in growing media allow height adjustment of each trap. Or, in greenhouses or shade structures, hang traps from rafters or wires strung between posts.

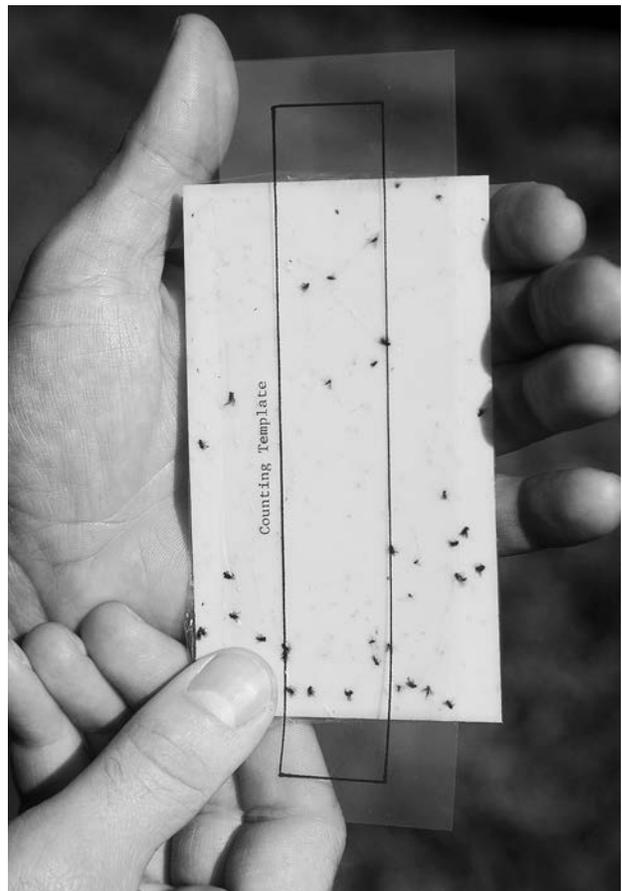


Figure 3. Quantitative estimates of insect populations can improve decision making and management effectiveness. However, it is not necessary to count every insect caught. An accurate estimate of pest populations can be obtained by counting only a 1-inch-wide (2.5-cm-wide) vertical column using a counting template placed over a trap wrapped in plastic, as illustrated here.



Plate 1. The fungus gnat (top) has long slender legs and antennae. Wings are light gray to clear without spots but with a Y-shaped vein (see fig. 5). The shore fly (right) has short bristlelike antennae with 3 to 5 pale spots on each wing. At lower left is a moth fly. Adult trapping can be combined with use of raw potato cubes imbedded in media to monitor root-feeding fungus gnat larvae (Harris, Oetting, and Gardner 1995) (see table 1).



Plate 2. A fungus gnat (left) is much larger than a thrips (center right) or a whitefly (far right). A second whitefly lays across one of the fungus gnat's legs (lower left). The whitish wings, and eventually the entire whitefly body, commonly become almost invisible in the trap adhesive within a few days after whiteflies are trapped. For this reason, whiteflies are easier to identify and count soon after they are trapped.



Plate 3. *Liriomyza* spp. and related leafminers are robust flies and are mostly black with bright yellow. Adults commonly have short bristles on their body and a conspicuous yellow patch on their thorax. Because yellow also attracts leafminer parasites (e.g., *Diglyphus begini*), sticky traps can be used to time and evaluate parasite releases for leafminer biological control (Heinz, Nunney, and Parrella 1993).



Plate 4. Thrips (left) and whiteflies (right) are often the tiniest insects you will find in any numbers in yellow sticky traps. Because most thrips are captured with their wings folded, they commonly appear spindle-shaped; antennae may protrude from the head in a V shape, and tiny hairs can be visible along the wing edges toward the rear. Shake or tap terminals over a collecting surface to dislodge and reveal thrips hidden in plants. For immature whiteflies, combine adult trapping with inspection of the underside of leaves.



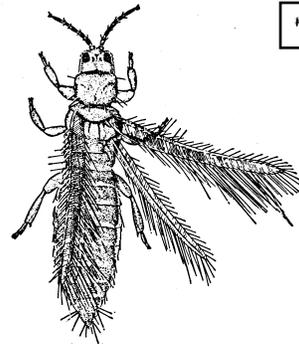
Plate 5. Winged adult aphid captured in a yellow sticky trap. Aphids have two parallel veins close to the front edge of their front wing. When trapped, aphids often have their wings spread on each side of their body. Traps are not the best aphid monitoring tool because most aphids are wingless, including reproductive adults; however, traps can indicate aphid hot spots and migration.



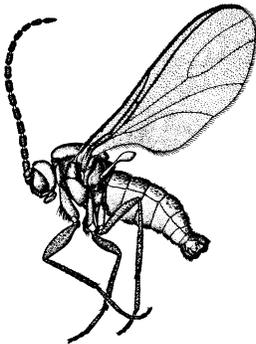
Plate 6. Many parasitic wasps, such as this chalcid aphid parasite, have mostly clear wings, often with only one distinct, angular vein along the front of each forewing. The hind wings often have no obvious veins and are smaller than the front wings. Although monitoring beneficial species is generally not a goal of trapping, traps can indicate the presence and relative abundance of certain natural enemies, such as parasitic wasps and aphid midges.



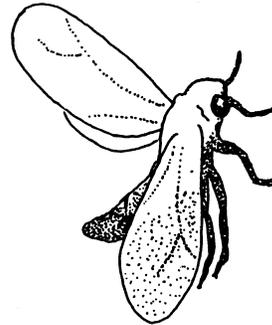
Leafminer. *Liriomyza* spp. (family Agromyzidae) are small, robust flies that are mostly black with areas of bright yellow. A conspicuous yellow patch is usually visible on their thorax. Unlike most other insects, flies (e.g., fungus gnats, leafminers, and shore flies) have only one pair of wings, not two pairs.



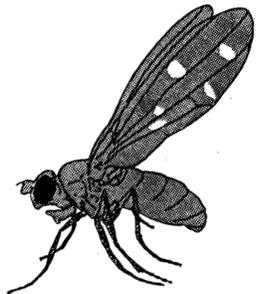
Thrips. Thripidae are tiny, elongate, narrow, blackish to yellow insects. Usually they are trapped with their wings folded over their body rather than spread out. Tiny hairs or fringes may be visible on the edge of wings. Thrips are often the smallest insect that are abundant in traps.



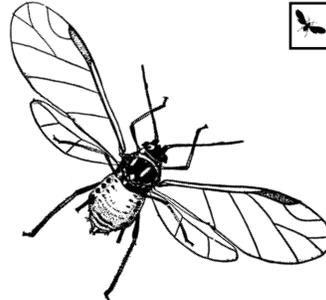
Fungus gnat. *Bradysia* spp. (Sciaridae) are delicate, slender, mosquito-like insects with long slender legs and antennae. Their bodies appear to be hunch-backed. The single pair of wings is light gray to clear and without spots but with a Y-shaped vein.



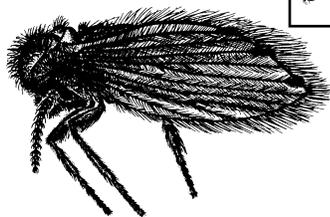
Whitefly. Aleyrodidae are tiny, delicate insects with orangish bodies. Their white, waxy wings may appear as a pale blotch near the body. The whitish wings, and eventually the entire body, become almost invisible in the trap adhesive within a few days after being trapped. Once the wings disappear, whiteflies can be confused with thrips.



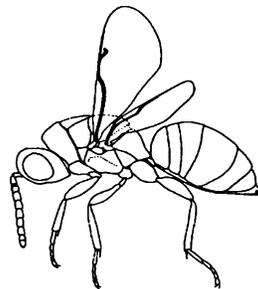
Shore fly. *Scatella stagnalis* (Ephydriidae) is a robust, dark fly with bristlelike antennae that are shorter than the head and not obvious. Each grayish wing has three to five pale spots. Often they are the largest flies found in traps.



Aphid. The bodies of aphids (Aphididae) usually shrivel up within a few days after they are trapped, leaving few parts recognizable. If fresh, the body is stocky and may have cornicles (a pair of tubes) visible near the rear. Front wings usually have two parallel veins close to the front edge. In the trap, the wings are often spread open on either side of the body. Their antennae and legs are long and thin. Trapped aphids sometimes give birth to several nymphs before they die.



Moth fly. Also called drain flies or filter flies (Psychodidae), they appear dark or grayish due to a covering of many fine hairs. Adults can be trapped in wet or poorly drained growing areas where fungus gnats and shore flies commonly occur. Larvae may feed on roots, but their importance in damaging crops is unknown.



Parasitic wasp. Many different Hymenoptera species occur, ranging from slender to stout. In comparison with flies, wasps usually have longer (often elbowed) antennae and their bodies may be more tapered (pointed) toward the rear. Many parasitic wasps have mostly clear wings, often with only one distinct, angular vein along the front of each forewing. The hind wings often have no obvious veins and are smaller than the front wings.

Figure 5. Characteristics for distinguishing common insects caught in yellow sticky traps. The approximate life size of each insect is indicated inside the boxes. Sources: Leafminer, and whitefly from Baker 1986; aphid by F. H. Chittendon from Sanderson and Jackson 1912; thrips from Anonymous 1952; shore fly and moth fly by C. Feller from Gorham 1991; fungus gnat from Gorham 1991; parasitic wasp from Grissell and Schauff 1990.

be time-consuming and messy. An alternative adhesive composed of one part petroleum jelly (e.g., Vaseline) or mineral oil mixed with one part household detergent can be used; however, some insects escape this material, and it may drip off boards under hot conditions unless applied thinly. Periodic cleaning or replacement of traps is essential to maintain the sticky surface.

Blue Traps

Blue sticky traps are often the most attractive to western flower thrips and some other thrips species (Brødsgaard 1989; Vernon and Gillespie 1990). Blue traps may be warranted for crops that are especially susceptible to thrips or where thrips are the major insect of concern, such as in African violets or roses. However, even though blue traps can capture more thrips, changes in the number of thrips caught in yellow traps may be a better indicator of thrips population changes in flowers. Insects can also be more difficult to discern against the darker blue background; in comparison with yellow traps, counts from blue traps may take longer and be less accurate. In crops such as chrysanthemums, which are affected by many pests, yellow traps can be more efficient because yellow (and not blue) attracts other insects, so the same yellow traps can be used to monitor many different pests.

THRESHOLDS

Many growers routinely apply pesticides on a calendar schedule, when pest presence is suspected, or when populations are already high and difficult to control. However, these growers are experiencing increasing difficulties for a variety of reasons. Total pest management costs over the production cycle can be expensive when calendar applications are used. Excessive spraying can make pesticides ineffective by promoting resistance to pesticides; applications sometimes injure plants (phytotoxicity), and increasing regulations (e.g., reentry intervals) make spraying more difficult.

In many cases, a certain number of pests and low levels of damage can be tolerated; this concept is fundamental to integrated pest management. It is often difficult to determine specific action thresholds and guidelines because the importance of pest presence or damage is determined by many factors, including the grower's tolerance.

It is best to begin monitoring pest populations before changing pest control practices. First learn what the trap catches reflect in comparison with pest injury and crop quality when using your conventional management practices. Then begin modifying control actions based on monitoring information. Growers who systematically monitor plants can develop their own thresholds, such as numbers of adults caught each week in well-maintained traps. Other types of numerical thresholds can be developed for most pest monitoring methods, including visual inspection

(e.g., percent of plants found infested) and shaking plants (e.g., the number of pests per shaken sample).

Because of the many variables and the lack of adequate research, growers in most cases must experiment over time to develop thresholds that are appropriate for their situations. Establish thresholds by judging the acceptability of the finished crop in comparison with your records of pest density monitored throughout that production cycle. Keep good records and be flexible in adjusting thresholds or adapting monitoring and management methods appropriately.

SELECTED TRAP SUPPLIERS

Gempler's

P.O. Box 270
Mt. Horeb, WI 53572
(800) 382-8473

Great Lakes IPM

10220 Church Road NE
Vestaburg, MI 48891
(517) 268-5693

Insect-A-Peel Systems

P.O. Box 1145
Marana, AZ 85653
(520) 682-0373

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Trece

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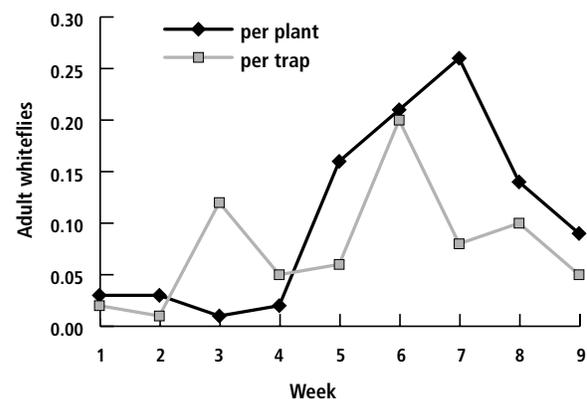


Figure 6. Whitefly sampling information summarized to facilitate comparison between trap catches and the number of insects found on plants. Both traps and plants were inspected once a week for adult whiteflies. Data show average numbers of whitefly adults per plant (black diamonds) and per trap (gray squares) in a greenhouse tomato crop monitored using 2 traps per 180 plants (Gillespie and Quiring 1987).

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