SUGARMAKER'S GUIDE TO PEAR THRIPS MONITORING

- Supporting Decisions for Management -

Margaret Skinner & Bruce L. Parker

Entomology Research Laboratory
Agricultural Experiment Station
The University of Vermont
Research Report 72

Department of Forests, Parks & Recreation
State of Vermont
Vermont Monitoring Cooperative Research Report 9

October, 1995

ABSTRACT

Pear thrips surfaced as a new pest of sugar maple, *Acer saccharum* Marsh., in 1979. Damage from this insect occurs intermittently, and threatens the long-term health of maple trees throughout the northeastern United States and parts of Canada. A method for sampling forest soil to determine pear thrips populations is described that is suitable for sugarmakers. This method requires a minimum of equipment and time, and provides sugarmakers with a reliable estimate of the number of thrips in their sugarbushes. By sampling and assessing damage annually, sugarmakers will gain an understanding of the relationship between thrips population levels and damage in their stands. Based on this information, potential damage in the spring can be estimated. Sample results are obtained before tapping so sugarmakers can adjust their management practices, such as the number of taps per tree, to minimize stress on trees when damage is likely.

Literature citation: M. Skinner & B.L. Parker. 1995. Sugarmaker's guide to pear thrips monitoring. Vt. Agric. Exp. Stn. Res. Rpt. 72 and VMC Res. Rpt. 9. Univ. of Vt., Burlington. 14 pp.

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Margaret Skinner & Bruce L. Parker

Entomology Research Laboratory
The University of Vermont
P.O. Box 53400
Burlington, VT 05405-3400

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Introduction

Pear thrips[a] first surfaced as a pest of sugar maple, *Acer saccharum* Marsh., in 1979. Since then it has caused damage intermittently throughout the northeastern United States and eastern Canada. It was introduced into the continental United States from Europe in the early 1900s. Its common name suggests a preference for pears, but it also feeds on apple, plum, cherry, beech, lilac, rose and many others. Though this tiny insect, less than 1/8 in. long (Fig. 1), was detected in the eastern United States around 1912, it was first linked with leaf damage to sugar maple in 1979 in Pennsylvania.[1] Not knowing the exact cause, people there first referred to the symptoms as a "maple malady". No one guessed that such a small insect could cause so much damage on large maple trees.

Pear thrips were detected in Vermont in 1985, though many believe damage attributed in the past to frost injury may have been caused by thrips. Since then they have been found throughout most of the range of sugar maple, from Maine to North Carolina, and west as far as Minnesota and Ontario.[1,2,3,4]

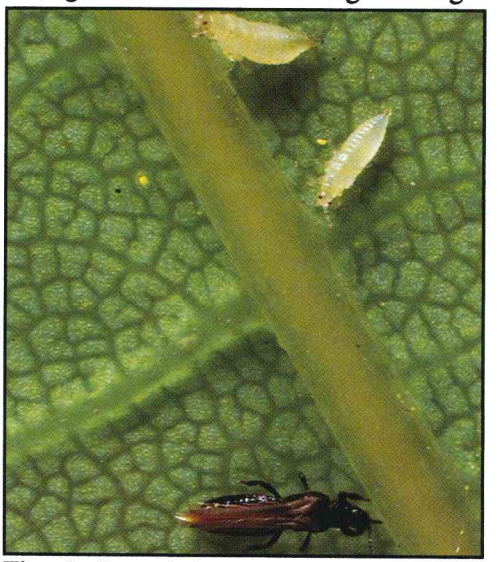

Fig. 1. Pear thrips adult and larvae on a sugar maple leaf (25x).

In 1988 extensive sugar maple damage was observed throughout much of the Northeast. Over 2 million acres of trees were affected regionally. The widespread damage caused great public concern and sugarmakers regionwide asked for assistance to manage this pest. The two most common questions they asked were "How many pear thrips do I have in my sugarbush and will there be damage next year?". To help sugarmakers answer these questions, the sampling method described herein was developed. It was designed especially for sugarmakers, requiring minimal equipment and time, yet providing reliable information on thrips populations. It has been thoroughly tested, and is proven to be effective for detecting the number of thrips in forest soil. By sampling for thrips and

[a] *Taeniothrips inconsequens* (Uzel), (Thysanoptera: Thripidae).

assessing their damage annually, sugarmakers will gain an understanding of the relationship between thrips population levels and damage in their individual stands. This will enable them to estimate the potential for damage. Because results are obtained before trees are tapped, sugarmakers can adjust their management practices, such as the number of taps per tree, to minimize stress when damage is likely.

Pear Thrips Biology

Insect pest management is rarely simple, and an understanding of the biology of the pest is essential. Based on research in Vermont, the pear thrips life cycle in northern New England has been determined. The timing of each life stage may vary regionally in response to climate, but the basic cycle remains the same.

Adult pear thrips emerge from the soil in mid-April, responding to warming temperatures. Emerging adults are light brown, but soon turn dark brown or black. They fly to host trees, seeking partially open buds. Early in the season they are commonly found in buds of striped maple, *Acer pensylvanicum* L., or hobblebush, *Viburnum alnifolium* Marsh., which tend to break bud before sugar maple. They migrate from these shrubs to the upper tree canopy when maple buds open. Once in the bud they feed on tender leaf and flower tissue enclosed within the bud scales. Thrips puncture plant cells and suck up the liquid contents. Because several leaves or flowers are tightly folded within each bud, it only takes a few thrips in a bud to cause significant damage at this stage of development.

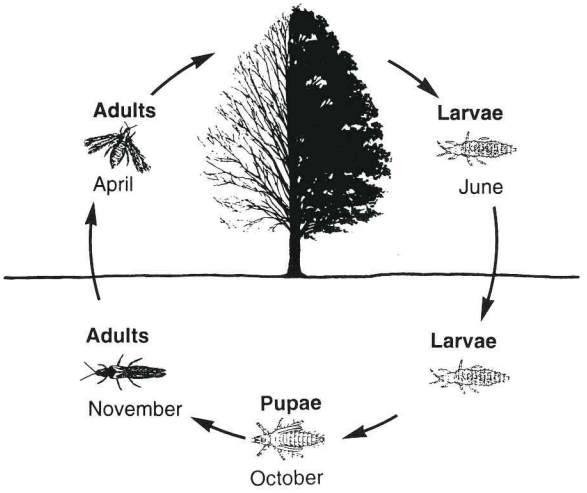

Fig. 2. Pear thrips life cycle in northern New England.

- **Adults cause most of the foliage damage to mature maple trees.**

As leaves expand, adults lay eggs in leaf stems and veins. In 6-7 days the eggs hatch into white, soft-bodied larvae with red eyes. They are

commonly found on the undersides of leaves at the base of the main vein. Larvae feed in the tree canopy for a few weeks before dropping to the forest floor in early June. They can be found in large numbers under fallen wilted leaves after a strong wind or heavy rain.

Larvae feed on understory vegetation, sometimes causing heavy damage to first-year maple seedlings. By late June most have entered the soil, where they construct an earthen cell in which to overwinter. Most are found at 4-6 in. below the soil surface. They pupate in September, and by mid-November reach adulthood, remaining inactive until temperatures rise sufficiently to trigger emergence. Adults are extremely cold tolerant during dormancy, and survive the winter even when the soil freezes around them.

Pear Thrips Monitoring Method

Soil Sampling and Inducing Thrips Emergence

Stand Selection and Set-Up. Pear thrips are commonly found in forests where maple predominates. Any sugarbush--tapped or untapped--or hardwood forest stand (at least 3-5 acres) with a high percentage of maple is suitable for sampling. In the center of the stand, select a live, dominant sugar maple tree, with a diameter at chest height of over 8 in. Then pick four other maple trees, one at the north, east, south and west corners at least 200 ft. from the center tree. Figure 3A shows a diagram of this stand arrangement. If the stand is long and narrow, select trees in a line through the middle, at least 200 ft apart (Fig. 3B).

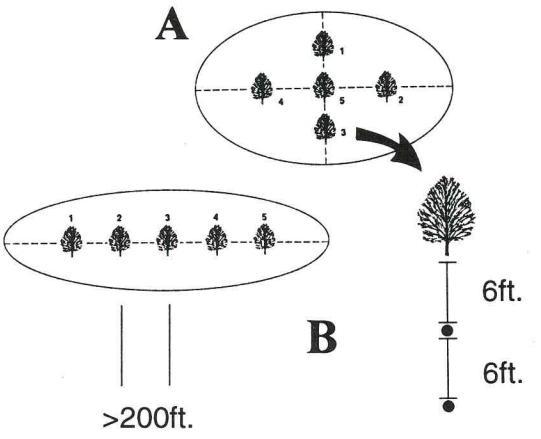

Fig. 3. Stand set-up for sampling. A) square or circular stands; B) long, narrow stands; ● = sample location.

Take two soil samples around each sample tree, one at 6 ft. and one at 12 ft. from the base of the tree, in any direction away from the tree. To facilitate future sampling, mark all sample trees with a metal tag or flagging.

Soil Sampling.

Equipment needed:

- 1 tulip bulb planter (3-in. top diameter, 4-in. length)
- 10 plastic freezer bags (6 by 3 by 15 in.)
- 1 waterproof marking pen

Sampling should be done as late in the fall as possible, but before the ground freezes or is covered with snow. In northern New England sampling is done in late November or early December. Brush away the leaf litter before taking the soil sample, and then press the bulb planter into the ground with rotating movements until the soil reaches the top of the tool (Fig. 4). Don't take a sample beyond the top of the tool because it won't fit into the emergence container. Remove the planter and put the soil in a plastic bag. In dry soils it may be necessary to reach into the hole to collect the remainder of the sample if it fell out of the planter. Usually the soil can be shaken from the sampler, but with wet or clay soils that get stuck, turn the planter upside down in the bag and push the soil out the top.

Fig. 4. Soil sampling with bulb planter.

If the planter cannot be forced all the way into the soil because of a large root or rock, remove any soil in the planter, and start over in another nearby location. Sometimes the soil is shallow, making it impossible to get a complete sample. If on the third try a complete sample cannot be obtained, take this sample anyway, even if it is not a full sample. Do not make a full sample by sampling in different locations and combining them. Label the bag with the sample site, tree number, date and distance from the tree, then close it.

- **Store samples out of the sun in a cool, dark place, preferably in a refrigerator. Do not let them freeze.**

They should be processed as soon as possible by the induced emergence method described in the next section.

Inducing Emergence.

Equipment needed:

- 10 plastic or paper wax-coated food containers (10 oz.; 3¾ in. diam., 4 in. ht.), with clear plastic covers, available at kitchen supply stores
- 30 clear plastic sheets (1-2 mil thick), cut into 7-in. squares
- Tanglefoot® sticky material (Tanglefoot Co., Grand Rapids, MI), available in a spray can from garden supply stores
- Magnifying glass, 10x

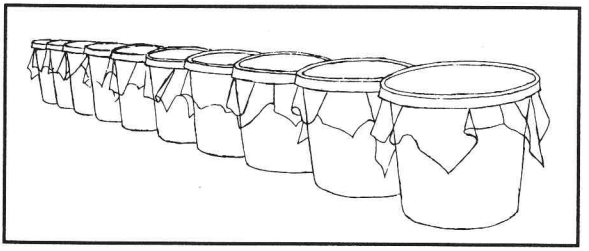

Fig. 5. Pear thrips induced emergence containers.

Before removing the soil from the cooler, prelabel ten plastic squares in one corner with the site name, tree number, sample distance and date when induced emergence was begun. Turn them over and coat each square with Tanglefoot® in the center on the underside, ensuring that the sticky surface is slightly larger than the top of the container (about 4 in. diam.). Place each soil sample in a separate container marked with the tree number and distance from the tree. Cover the top of the container with a plastic square, sticky side down, making sure the soil does not touch the sticky surface. Secure this sticky lid with the clear plastic cover or rubber band if you don't have a cover (Fig. 5).

Keep the containers at room temperature (60-75°F) for 35 days, away from direct sunlight and heat. Thrips will emerge naturally and stick to the lid. You can check the progress of emergence from time to time, but take care not to let thrips escape that have not become stuck to the lid.

After 35 days, remove the sticky lids and cover them with a clear non-sticky plastic square, marking it with the date it was removed. If the sticky lid becomes covered with insects (such as springtails, etc.), before the 35-day period has expired, replace it with a new one. Inspect ALL lids with a magnifying glass and circle each thrips with a waterproof marker (Fig. 6). Count the number of pear thrips that emerged and record it on the data sheet (page 9).

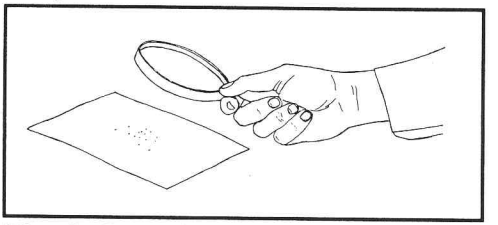

Fig. 6. Inspection of plastic lid for thrips.

Thrips are very small, and may be difficult to see. They are about the size of a flea, but longer and narrower (Fig. 7). They range in color from light honey-brown to dark brown or black. Figure 8 shows what pear thrips look like when captured on the sticky lid. Some may appear curved rather than straight. This is a result of their movement following touching the sticky surface.

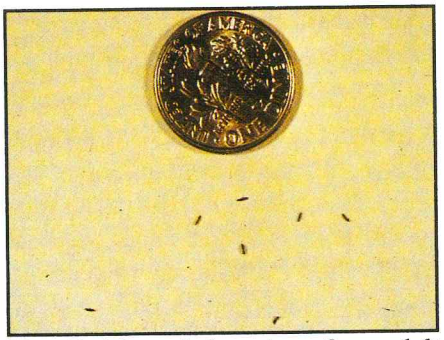

Fig. 7. The relative size of an adult pear thrips. Photo by R. Kelley.

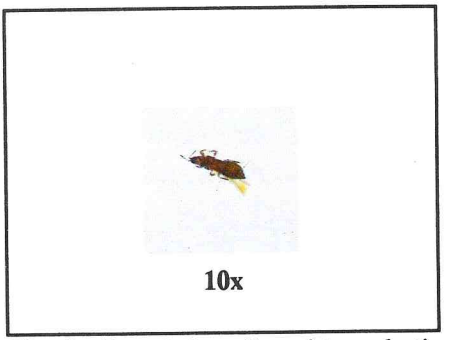

Fig. 8. Pear thrips adhered to a plastic sticky lid after emerging from soil.

There are a few other insects that look similar to pear thrips, which are commonly captured on sticky lids. *Leptothrips mali* is a jet black thrips with a long, narrow body, and is larger than a pear thrips (Fig. 9). It is a predator of thrips and other small insects. Collembola (also called springtails or snow fleas) are about the same size as pear thrips, but their body is rounded, and the antennae are short and thick (Fig. 10). They range in color from dark grey to pink or red. They are harmless insects found in large numbers in the forest and generally feed on dead and decaying matter. Should you feel uncertain of your identification, contact a pest specialist in your area.

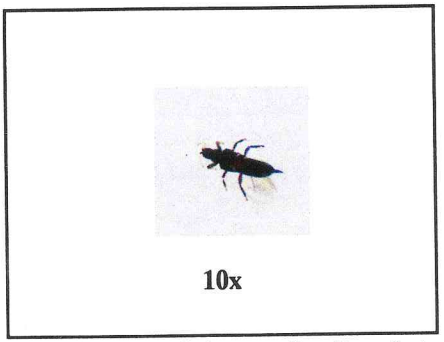

Fig. 9. *Leptothrips mali* adhered to sticky lid after emerging from soil.

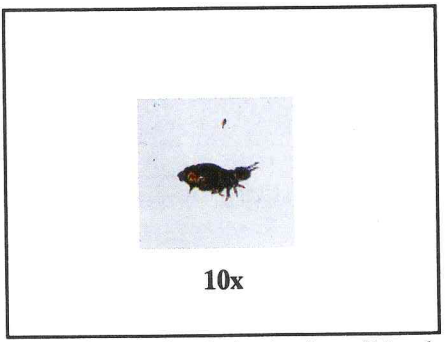

Fig. 10. Collembola (springtails) adhered to a sticky lid.

Interpretation of Results

The relationship between the number of thrips in the soil in November and the amount of damage that results in the spring is complex.[5,6] Weather, including how much snow fell over the winter, and spring air temperatures, appears to play an important role, as may the aspect and elevation of a stand. Most damage is done by the adults when the leaves are enclosed in the bud. In some years, thrips emerge early over a short time period because of warm temperatures or frost-free ground. This may result in the presence of many thrips in the trees at a time when the foliage is particularly sensitive to their feeding. If bud development is slow, relatively few thrips are needed to cause heavy damage to the tender leaflets. However, in years when maple buds expand into leaves quickly, thrips have a large surface area on which to feed, thereby reducing the potential for damage, even if thrips populations are high. In Vermont damage has resulted in stands with an average of 4 thrips per sample. Therefore, if 4 or more are found in the soil samples, sugarmakers should expect damage, though the severity will depend on spring weather conditions. By sampling and assessing damage annually, sugarmakers will gain an understanding of the relationship between thrips population levels and damage in their stands.

To date there is no evidence that a single year of heavy thrips defoliation will kill a tree, but it is a significant stress factor. If a stand has experienced one or more years of moderate or heavy thrips damage, and pear thrips populations are high, other potential stresses should be minimized.[7,8] Therefore, reduce taps on threatened trees and consider delaying the thinning of the stand until the trees have had a year to recover. Refer additional questions regarding management to your local forestry specialist.

Damage Assessment

A standard method to assess thrips damage from the ground in a maple stand has been developed.[9] This enables sugarmakers to evaluate the relationship between the number of thrips obtained in soil samples in the winter and the amount of damage resulting in the spring. Damage assessment is an important component of long-term forest health management, and is essential to maximize information gained from thrips sampling.

The assessment of damage should be done in mid- to late-June, when thrips have stopped feeding and returned to the soil. Make assessments on individual mature maple trees, saplings, 1-2-year old maple seedlings, and the stand as a whole. First examine with binoculars the upper and lower branches of each of the 5 sample trees at several angles. Using the rating system in Table 1 and Fig. 11 as a guide, record the average level of damage

observed in the crown on the data sheet and calculate the average rate of damage for these trees. Next assess the average damage on all saplings and seedlings located within 6-10 ft. of each sample tree and calculate an average damage rate for each of these categories. Large variation in the level of damage among trees sometimes occurs. Therefore, scan all maple trees near the sample trees to determine the overall stand damage.

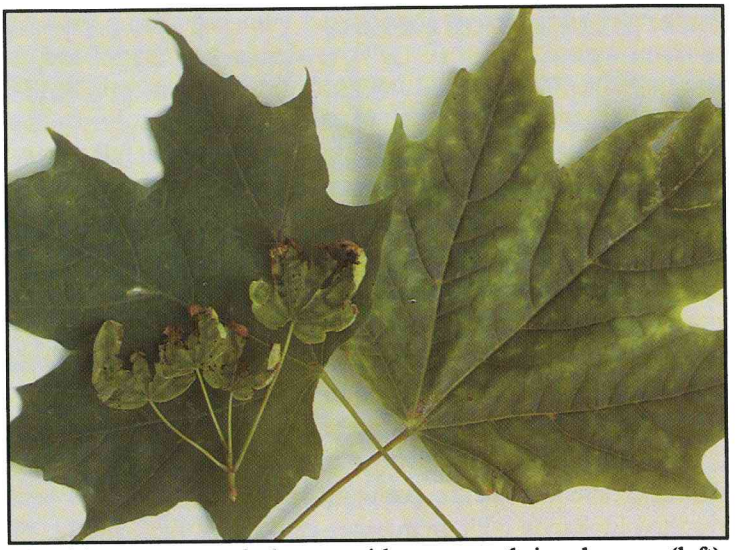

Fig. 11. Sugar maple leaves with no pear thrips damage (left), light damage (right), and severe damage (center).

Table 1. Pear thrips damage rating system for maple trees

Rate[a]	Damage Level	Description
0	None	**No pear thrips damage** detectable.
1	Light	Most **leaves mottled** with yellow spots, some **slightly stunted or puckered.** Leaf area reduced by 1-30%.
2	Moderate	Most **leaves stunted, deformed and browned at the leaf edges.** Some leaves may be tattered. Leaf area reduced by 31-60%
3	Heavy	Most **leaves tattered** and **severely stunted.** Some buds may be killed. Leaf area is reduced by 61-80%.
4	Severe	**Near or complete defoliation.** Leaf area reduced by 81-100%.

[a] If damage falls between two categories, use numerical gradations, e.g., 3.5 or 3.75 for damage that is very heavy but not quite severe.

Sample Data Sheet

Pear Thrips Induced Emergence

Stand Name: _____ Date of Soil Sampling: _____

Date Inducing Begun: _____ Date Complete: _____

Dist-ance	Total thrips that emerged per sample					Grand total # of thrips	Grand total # of thrips ÷ 10 = Avg. thrips per soil sample
	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5		
6 ft							
12 ft							
Total							

Pear Thrips Damage

Date of Damage Assessment: _____

	Damage rating		
	Canopy	Saplings	Seedlings
Tree 1			
Tree 2			
Tree 3			
Tree 4			
Tree 5			
Total			
Average (÷ 5)			

Overall Stand Damage Rate: _____

Other Comments: _____

Alternative Monitoring Methods

There are several other methods available to monitor pear thrips populations. What follows is a brief explanation of each and our assessment of their value to sugarmakers.

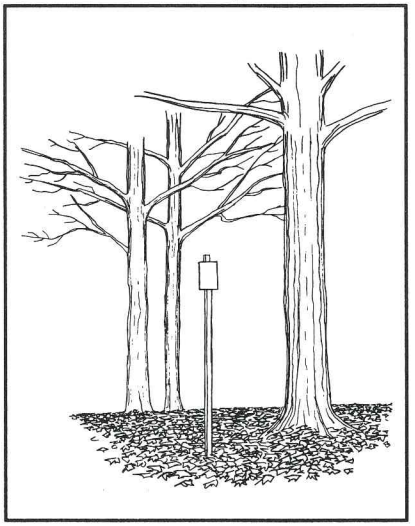

Fig. 12. Sticky card trap on stick.

Sticky Card Traps. Four yellow cards (3 by 5 in.) are placed 3 ft. above the ground (Fig. 12).[10] They are coated on both sides with sticky material, and can be purchased from pest management supply companies[b]. There should be a distance of at least 100 ft. between traps and none should be located within 100 ft. of the edge of the sugarbush. These cards are placed in the stand before thrips emerge (early April in New England) and as sugar maple buds begin to swell in the spring. They are inspected weekly or bimonthly to check for adult thrips. Data from these traps indicate if and when pear thrips are present, but the number of thrips on sticky traps has not been found to relate directly to damage. As data from the traps are not available prior to tapping, sugarmakers cannot use them to make decisions relative to their production practices.

Emergence Traps. PVC (polyvinyl chloride) schedule 40 pipe (3-in. diam.) is cut into 6 in. lengths (Fig. 13).[11] Each pipe has two ¾-in. ventilation holes drilled on opposite sides 1 in. from the upper edge. These holes are covered on the inside with a 125-micron mesh screen.[c] Traps are placed upright on the ground and covered with a clear plastic square coated on one side with sticky material (Tanglefoot Co., Grand Rapids, MI) and held in place with a rubber band. Five sugar maple trees are selected in the stand in

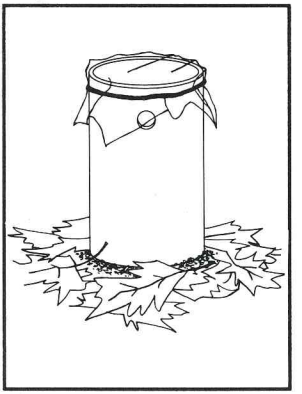

Fig. 13. Pear thrips emergence trap.

[b] For example, Pest Management Supply Co., Amherst, MA.

[c] This fine mesh can be purchased from Tetco Inc., Briarcliff, NY.

the manner described for soil sampling and two traps are placed under the canopy at least 6 ft. apart under each tree. Sticky lids are removed periodically and the number of adult thrips caught are counted. A non-sticky square of clear plastic is placed over the lid for closer inspection with a magnifying glass. Like the sticky cards, the information is not received in time to enable sugarmakers to make management decisions regarding their tapping practices. The method also takes considerable time during a period when most sugarmakers are busy with cleaning tubing or spring planting.

Bud Counts. In the spring as the temperatures moderate, expanding sugar maple buds are sampled and the number of thrips found within are counted.[12] Without a pole pruner or the services of a tree climber, sampling is limited to understory trees. The relationship between thrips counts in these understory trees and counts in dominant sugar maples is unknown. However, if this is done in the same stand each year, sugarmakers will gain a sense for annual fluctuations in thrips populations. Like the two former sampling methods, the information generated from bud counts does not help sugarmakers with the current year's management decisions.

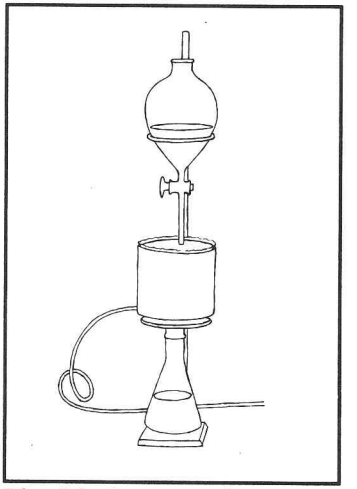

Fig. 14. Apparatus for extracting thrips from soil.

Soil Extraction. Thrips can be extracted from soil samples using a heptane flotation procedure.[13] For pear thrips monitoring, samples are taken with a bulb planter. The heptane flotation method takes about 1 h per sample, and requires expensive equipment and a degree of scientific experience to complete (Fig. 14). The results obtained supply sugarmakers or researchers with a reliable estimate of thrips populations and provide adequate time to make appropriate decisions relevant to production practices. Because of its complexity, this method is not recommended for use by sugarmakers.

Metric Conversion Table

1 inch = 2.54 cm	1 oz. = 28.35 grams
1 foot = 0.30 meters	°C = (°F-32) x 5/9
1 acre = 0.4 hectares	

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ACKNOWLEDGMENTS

Prior to publication, this field guide was reviewed by H. Brenton Teillon, Sandra H. Wilmot and Gaylord Reed, Forest Protection, VT Dept. of Forests, Parks & Recreation; James P. Linnane, U.S. Forest Service, Forest Health Protection; Lawrence B. Myott, Univ. of VT Extension System, and the following sugarmakers, Wilson Clark, Peter R. Purinton, Arthur H. Packard, Jr., Robert White, Lynn H. Reynolds and Darrell F. Russ. Figures were drawn by Robert L. Fardelmann, Univ. of VT, and pear thrips color photos were taken by Tony E. Downer, Burlington, VT. This work was supported by grants from the USDA, Forest Service, Northeastern Area State & Private Forestry (Coop. Agreement No. 42-702); Univ. of VT Extension System; Vermont Maple Sugar Makers Association, Chittenden County Maple Sugar Makers Association, and the North American Maple Syrup Council.

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