
**DISPERAL OF VEGETABLE LEAFMINER**
**INTO A TRANSPLANT PRODUCTION RANGE**

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**ABSTRACT**

Experiments were conducted on a commercial vegetable and ornamental transplant range in Sun City, FL during the 1977 fall and winter to determine attraction of various trap colors and to monitor leafminer dispersal into the range.

Significantly more adult flies were captured on yellow traps than on yellow-green, orange, green and blue. Use of a protective transparent plastic bag on the yellow poster board traps had no significant effect on the number of adult flies trapped. Significantly more flies were trapped on cards located on the periphery of the range nearest the prevailing wind and within 100 ft of commercial tomato farms. Fly movement onto the transplant production range and infestation within production houses reflected both proximity of source and prevailing wind direction.

The vegetable leafminer, *Liriomyza sativae* Blanchard, is a serious pest of Florida vegetables (Musgrave et al. 1975). The leafminer female directly damages its host by repeated insertions of the ovipositor into the upper leaf surface, leaving punctures (stipples) ca. 0.35 mm in diameter. The oviposition insertions permit: 1) feeding from the exudate or 2) the deposition of an egg (Elmore 1954). The oviposited egg hatches in 2-4 days into a maggot which feeds through the leaf mesophyll creating the characteristic serpentine mine. After 3-6 days the maggot emerges from the mine, and pupates in a 2-3 mm golden brown puparium. The adult emerges 9-14 days later, completing the cycle (Musgrave et al. 1975).

Research in Florida agriculture currently emphasizes integrated controls in an effort to effectively manage the leafminer in celery and tomatoes. A primary thrust in this research is to find alternative or complementary tactics to the use of chemical insecticides. Leafminer population levels remain low longer when healthy transplants free of leafminers are used. Many Florida commercial tomato and celery fields (70% and 5%, respectively) begin with transplants (Fla. Agr. Statistics 1977-78) that must be pest-free (Tauber 1977). This zero insect threshold precludes the use of biological

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1*Liriomyza sativae* Blanchard.
2Agriculture Experiment Station Journal Series No. 1975.
Tryon et al.: Dispersal of Leafminers

control in the production of transplants and is achieved by total reliance on chemicals to protect the plants. However, certain cultural practices and information about the leafminer, its dispersal, source, and invasion into transplant production ranges and host preference within the houses are needed to make control programs more efficient. Leafminer dispersal patterns are not well known. Oatman and Michelbacher (1958) and Webster and Parks (1913) found initial vegetable field infestations of leafminer (Liriomyza spp., no voucher specimens) confined to clusters on plants along the field edges bordered by untreated weeds and irrigation ditch banks. This localized invasion or ‘edging affect’ was a result of these leafminer populations traveling only short distances. Wolfenbarger (1961) found vegetable leafminer dispersal at comparatively short distances (<100 ft).

Experiments were conducted to measure adult vegetable leafminers movement onto a transplant production range and into greenhouses from nearby commercial tomato farms.

**Materials and Methods**

Experiments were conducted in Sun City, FL, at a commercial growing range where vegetable and ornamental transplants are produced. The production range consists of 100 or more houses (>7,500 total ft²/house), with semi-transparent fiber glass roofs and semi-transparent polyethylene plastic sides that can be raised or lowered to maintain a more uniform environment. The production range is closely surrounded by 15,000 A of commercial tomato fields.

Sticky traps were used to detect invasion of the production range by adult vegetable leafminers. Preliminary tests were done to determine the influence of trap color on catch of leafminers. Yellow, yellow-green, orange, green, and blue poster board sections (7 in x 7 in) were stapled to 12 in wooden stakes. The 5 colors were selected because of previous experience with colored cards (Poe, pers. comm.). Tack Trap® was spread uniformly on both sides of the cardboard.

Six card traps of each color, randomly located in a nearby commercial tomato field, were observed after 24 h on 3 dates in November 1977. In subsequent tests, transparent plastic bags were slipped over the yellow trap board and Tack Trap® was applied to the bag.

Subsequently, yellow cards protected by plastic bags coated on both sides with adhesive were used to measure vegetable leafminer movement onto the production range. Seven sites (road edges) surrounding the outer edge of the range (with 120 houses) an equal distance apart (≈0.5 mi), were selected to monitor direction of vegetable leafminer movement after 24 h of exposure on 25 November, 3, 12, 19, and 26 December, 1977 and 5 January, 1978. New plastic bags were placed over the trap after each observation date. On each date the prevailing wind direction during the time of exposure was determined by personal observation and verified by records of the U.S. Weather Bureau at the Tampa International Airport.

‘Walter’ tomato transplants (6 to 10 weeks old) in a large production house (7,000 ft²) were observed to determine the region within the house of earliest leafminer activity. The house was sectioned into 4 equal quadrants (75 ft x 25 ft; 45,000 transplants), subdivided into 4 subquadrants (18 ft x 3 ft). The numbers of active mines from 100 tomato seedling leaflets ran-
domly selected were recorded for each quadrant and subquadrant on 19, 23, and 27 October and 4, 8, and 14 November, 1977.

RESULTS AND DISCUSSION

Sticky trap data (Table 1) provide quantitative information necessary for the early detection of invading vegetable leafminers. The mean number of leafminer adults captured on various trap colors were as follows: yellow 84, yellow-green 14, orange 7, green 4, blue 3 and transparent plastic covered yellow 29 (N=6, L.S.D. =9.9, P=0.05). Yellow and yellow covered with plastic were significantly more effective than the other trap colors in attracting adult leafminers. Only the yellow traps were tested with a plastic cover after yellow was found to be the most effective relative to the other 4 colors in attracting flies. Cards wet by rain, dew, and sprays faded and became misshapen, given inconsistent trap catches. The use of the transparent plastic bags with Tack Trap® protected the yellow card without diminishing its attraction to vegetable leafminers.

Sticky traps located on boarders of the transplant production range made directional detection of invading leafminers possible (Table 1). The prevailing winds in the Tampa Bay area are generally unidirectional during daylight hours in November and December. This influenced the direction of leafminer invasions. Trap sites located on the edge of the range nearest the prevailing winds and in direct line with nearby commercial tomato fields trapped the largest number of adult leafminers.

On each of 6 sampling dates, counts of leafminer adults from 7 trap sites on the periphery of the farm indicated a relationship between wind direction and relative location of the traps. The most flies were trapped on the windward side of the farm and the fewest were taken on the leeward side: i.e. 23.2 flies/trap (windward), 26.2, 14.7, 10.7, 5.5, 4.4, and 3.8 (leeward, L.S.D. =6.2, P=0.05, N=4). Personal observation indicated that numbers of trapped flies declined when wind gusts during the daylight hours were >20 mph. The flies appeared to disperse faster at higher than at lower

<table>
<thead>
<tr>
<th>Date (mo/da)</th>
<th>Predominant 24 h wind direction*</th>
<th>Average no. adult leafminers**/trap site facing</th>
</tr>
</thead>
<tbody>
<tr>
<td>XI/25</td>
<td>NW</td>
<td>NE† E SE SW W NW N</td>
</tr>
<tr>
<td>XII/8</td>
<td>W</td>
<td>23 3 2 7 12 40 44</td>
</tr>
<tr>
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<td>NW</td>
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<td>N</td>
<td>9 2 1 3 17 33 25</td>
</tr>
<tr>
<td>XII/26</td>
<td>N</td>
<td>4 1 2 6 14 12 6</td>
</tr>
<tr>
<td>I/5</td>
<td>NW</td>
<td>1 1 2 3 4 0 2</td>
</tr>
</tbody>
</table>

*U.S. Weather Station, Tampa, FL.
**To nearest whole number.
†Trap site direction relative to location on the periphery of the range.
temperatures. Most of the adult vegetable leaf miners were trapped during the warmer part of the day (≈10 AM to 3 PM). Trap counts suggested that the principal source of leaf miner invasions was commercial tomato fields. Sanitary practices and intense insecticide use had eliminated the transplant range as a source of adult leaf miners.

Adult vegetable leaf miner trap counts for a 24 h period averaged 29 per trap in a nearby tomato field, 16 per trap 100 ft away, 10 per trap at the NW edge of the production range nearest the source, and less than 1 per trap on the SE edge of the range for 25 observations during November and December 1977. The commercial tomato fields in the area were abandoned after harvest (late November and December 1977, and January 1978). Leaf miners produced on the crop residue invaded downwind transplant houses and made production of pest-free transplants difficult, even with the constant use of pesticides. This problem could be prevented by destruction of crop residue and sanitation (Poe 1973, and Kelsheimer 1961).

Localized (NW quadrant) adult activity within the house (slides down during the day) made scouting for leaf miner damage less time consuming. On the 6 dates during October and November 1977, 100 randomly selected tomato transplants 6-8 weeks old were examined in each quadrant for active mines. The average number of leaf miners per 100 plants from the 4 quadrants was: NW=5.9, SW=8.9, NE=1.9 and SE=1.5 (L.S.D.=1.4, N=12, P=0.05). Seedlings in the NW quadrant, the area exposed first to the prevailing wind, had a significantly greater number of mines. The NW quadrant was subdivided in 4 subquadrants and examined for active mines per 100 tomato transplants on 3 dates in November (NW=6.9, SW=6.5, NE=5.3, and SE=4.9, L.S.D.=1.39, N=6, P=0.05). There were few significant differences between active mine counts in the NW subquadrants although the transplants on the outer edge of the transplant house (NW and SW subquadrants) had the greatest number of active mines. Oatman and Michelbacher (1958) reported this “edging effect” from initial field infestations on tomatoes along edges bordered by untreated weeds serving as a leaf mineral source.

The use of yellow sticky traps, knowledge of the source of leaf miner adult populations and transplant house areas which show early oviposition and stippling preferences make monitoring a transplant production range for leafminer invasions less time consuming.

LITERATURE CITED

TWO NEW GENERA OF NEARCTIC HEPTAGENIIDAE
(EPHEMEROPTERA)

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ABSTRACT

The Nearctic species of _Heptagenia_ Walsh are herein divided into 3 genera: _Heptagenia_; _Leucrocota_ Flowers, n. gen.; and _Nize_ Flowers, n. gen. _Leucrocota_ corresponds to the _maculipennis_ group of _Heptagenia_ while _Nize_ corresponds to the _lucidipennis_ and _simplicioides_ groups (all as originally discussed by Traver). The _lucidipennis_ and _simplicioides_ groups represent subgenera of _Nize, Nize_ s.s. and _Akkarium_ Flowers, n. subgen. Descriptions and keys to male imagos and mature nymphs are provided.

Recent research has confirmed what has long been suspected by many mayfly workers: the widespread Northern Hemisphere genus _Heptagenia_ Walsh is polyphyletic. Bogoscu and Tabacaru (1962) transferred a number of European species from _Heptagenia_ to _Ecdyonurus_. Flowers (1980) showed that there are substantial morphological differences among the Nearctic species of _Heptagenia_. Careful study of imaginal, nymphal, and egg characters revealed that those species treated as the _maculipennis, lucidipennis_, and _simplicioides_ groups of _Heptagenia_ by Traver (1933) have closer affinities to _Ecdyonurus_ and its allied genera than to the remaining Nearctic _Heptagenia_, which were termed the _flavescens-pulla-elegantula_ group by Traver (1933).

As treated herein, the 10 species of the _maculipennis_ group represent 1 new genus and the 11 species of the _lucidipennis_ and _simplicioides_ groups represent a second new genus with 2 distinct subgenera. _Heptagenia_ (Fig. 1, 4, 7, 10, 13-14, 19, 22-24) in the Nearctic is now considered to include the following species: _H. adequata_ McDunnough, _H. cruenta_ Walsh, _H. diabasia_ Burks, _H. dolosa_ Traver, _H. elegantula_ (Eaton), _H. flavescens_ (Walsh), _H. julia_ Traver, _H. marginalis_ Banks, _H. patoka_ Burks, _H. pulia_ (Clemens), _H. solitaria_ McDunnough and _H. townensi_ Traver. All these species (the _flavescens-pulla-elegantula_ group of Traver) show close affinities to _H.