Research Article

Studying Some Environmental Aspects of Leaf-Miner on the Plant Leaves in the Al-Muthanna Governorate

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Abstract |The results of this study are conducted during the period from 01\ 10 \ 2023 to 01 \ 04\ 2024. It showed that the recording of four species of tunnel makers; *Agromyza albipenniss*, *Liriomyza orbona*, *Liriomyza trifolii*, and *Phytomyza horticola*, have been infecting twenty important economic plant families . The highest insect density was recorded in terms of the number of tunnels per insect during March 2024, which amounted to 45 tunnels, while the lowest number of tunnels was recorded during the December 2023, with only two tunnels. The highest rate of insect infestation was recorded during two peaks in the autumn and spring season, as the results showed. The infection rate during March has reached 90%, followed by the fall peak in October was 76%, while the lowest percentage of infestation was recorded during the December and January, reaching 2% and 4%, respectively. The results of the study also showed that the larvae dig tunnels of different shapes that may be straight, winding, irregular, or on the form of a spot.

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Introduction

There are many insects that are economically harmful to agricultural crops, especially those species that feed on the vegetative part of the plant. Among the most important agricultural crops that are affected by harmful insects belong to important economic plant families. The leaf miner insect is considered one of the economically harmful insects that attack the leaves of various plants(Dursun *et al*., 2010, Atshan *et al*., 2024) The leaf tunnel maker family, Agromyzidae, is one of the largest families of the Diptera order, which includes more than 3,000 species belonging to 30 genera spread throughout the world (Civelek, 2002), and includes many species that are economically important and destructive to production in multiple agricultural ecosystems (Dousti, 2010, Spencer, 1973). It attacks the epidermis and leaves of the plant, creating tunnels that are either longitudinal or transverse. This insect feeds on the layer of cells that is located between the epidermis of the leaf. The tunnel maker creates tunnels and winding passages, leaving behind excretory wastes that appear visible on the sides of the tunnels and in the form of threads. The tunnels are usually characterized by the presence of two identical circular holes. Those insects cause varying damage to plant leaves and may lead to the leaves withering, drying out, and/or death (Abul-Nasr, 1961, Al-Ameri *et al*., 2025).

The damage caused by the types of leaf-miners arises from the larvae that dig between the epidermis of the leaves, causing white and winding tunnels. This causes yellowing and drying of the leaves, when numbers of tunnels are increased. In addition of the damage caused by the larvae, there is other damage caused by the leaf-miner adults which are feeding on the cellular juice of the leaf tissues. The insect females have made a hole through leaf epidermis using the egg-laying machine (Griffiths, 1980; Fagoonee and Toory, 1984), they begin by piercing the leaf by bending the abdomen to prick the leaf with several pricks using an egg-laying machine in order to create a hole in the surface of a leaf, and this causes damage to the mesophyll cells. The female may lay eggs inside these holes, as the female feeds through these holes (Minkenberg and Helderman, 1990; Tramble *et al*., 1985) interpreted that, feeding a larva greatly reduces photosynthesis, in fact there is a significant reduction in height, leaf and branch numbers of the plants. The leaf miner adults have spread and expanded in Iraq, and it has damage to many vegetables, ornamental shrub plants, which causes severe damage to the leaves during early infestations.

Materials and Methods

Three areas were selected to collect the trail samples; (Al-Samawa, Al-Khuder, and Al-Rumaitha). Samples were collected for the period from 01/10/2023 to 01/04/2024. 50 leaves were collected containing tunnel-making larvae and pupae from the trail plants (tomato, cucumber, eggplant, castor, basil, fenugreek, okra, peas, dandelions leaf, chrysanthemum and tent rose). The data collected weekly from the beginning of the symptoms appearing on the leaves until their presence disappears on the plants. The collecting leaves were brought to the insect's laboratory at the college of agriculture at the Al-Muthanna University. Each leaf was placed in a petri dish and covered with a piece of gauze until the adult insects emerged. The adult insects were preserved in 70% alcohol. The samples were diagnosed using a Dino-lite (digital microscope) and a dissecting microscope was used (MB. Mariobroma. SRI., Roma) and diagnosed and classified based on diagnostic characters and taxonomic keys (Spencer and Steyskal, 1986). The numerical density of insects was calculated based on the number of tunnels in the leaf. The research results were analyzed statistically according to the Genstat statistical program. The results were compared using the least significant difference test at the 5% level.

Results and Discussion

Table 1 shows the diversity and wide range of leaf miners, which have been recorded on 11 plant families. This indicates that these leaf miner's non-specialist for a specific family, their nutritional preference is according to the period of emergence and according to the type. The highest densities were recorded on the mother of milk plant at a time when no densities were recorded on the castor plant.

Table 1: *Types of hosts and plant families attacked by leaf-miner.*

Family	Scientific name	Host plant	No
Solanaceae	*Solanum lycopersicum*	Tomato	1
	Solanum melongena	Eggplant	2
	Cucumis sativus	Cucumber	3
Labiaceae	*Ocimum basilicum*	Basil	4
	Mentha piperita	Mentha	5
Fabaceae	*Vicia faba*	Broad been	6
	Medicago sativa	Lucern	7
	Trigonella cylindracea	Fenugreek	8
	Melilotus indicus	Melilot	9
Euphorbiaceae	*Ricinus communis*	Castor oil plant	10
Malvaceae	*Abelmoschus esculentus*	Okra	11
	Malva parviflora	Malva	12
	Althaea officinalis	Marsh mallow	13
Tropaeolaceae	*Tropaeolum majus*	Indian cress	14
Asteraceae	*Sonchus oleraceus*	Sowthistle	15
	Calendula officinalis	Feverfew	16
Comosita	*Schoenus nigricans*	Schoenus	17
Caesalpiniaceae	*Senna alexandrina*	Senna	18
Aracea	*Luffa aegyptiaca*	Luffa	19
Amaranhtaceae	*Atriplex repens*	Atriplex	20

Leaf miners infect many families of economic importance plants, such as the Cucurbitaceae, Solanaceae, Fabaceae, and Asteraceae families. In

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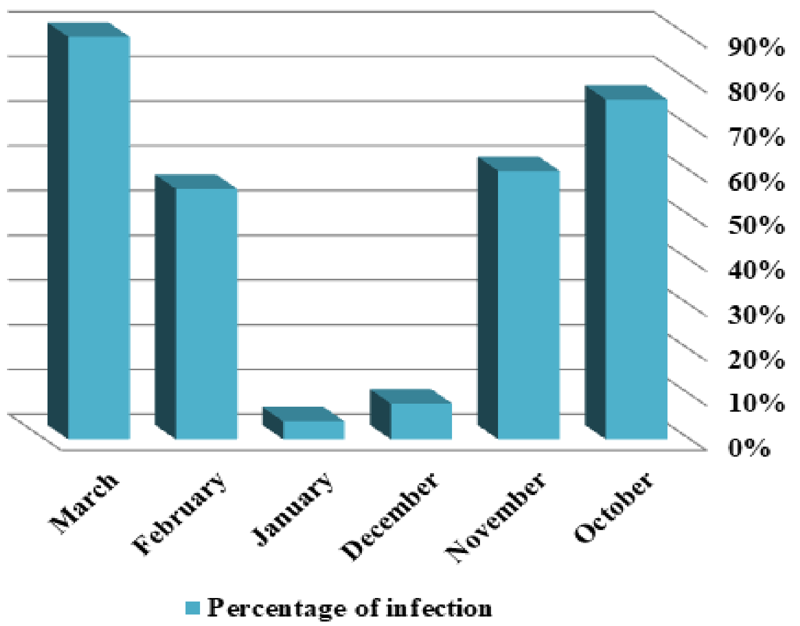

Figure 1: *Percentage of infection with leaf miner.*

addition, they attack ornamental plants all over the world (Kang *et al*., 2009; Yang *et al*., 2021). The plant host and the chemical content of the host, where the highest densities were recorded at the beginning of emergence on the castor plant, while in the second emergence period during the months of February and March.

Table 2 shows the highest number of leaf miner tunnels recorded during October 2023, at 38/50 leaves, and March 2024, at 45/50 leaves, respectively, while the lowest expenditure densities were recorded during January and December. At the rate of 2 tunnels/50 and 4 tunnels/50 of leaf, respectively. The eggs of the leaf miner maker *Liriomyza sativae* is located singly in the holes in the leaf epidermis and there is no preference for the upper or lower surface of the leaf (Capinera, 2001; Al-Jassani, *et al*., 2020).

Table 2: *Numerical density according to expenditure during the sampling period by month.*

Number of spending	Total leaves	Month	No
38	50	October	**1**
30	50	November	**2**
4	50	December	**3**
2	50	January	**4**
28	50	February	**5**
45	50	March	**6**

Figure (1) shows the recording of the beginning of the leaf miner marsh in October on the castor bean plant, with very high densities, and these densities continued to rise during November 2023. Then the number of leaf miner decreased significantly during the December and January, this may be due to the entry of leaf miner into hibernation for the winter, due to the low temperatures and heavy rain during this season. The insect density began to rise again during the February and March, where its highest densities were recorded in the third week of February.

From the above, it is clear why the insect is not active during the winter in a field and is confined to greenhouses with a warm weather, Frederick *et al.* (1991) indicated that the *L. sativae larvae* needs a heat accumulation of 95 units in order to emerge from the tunnel at the end of third life. This is what makes the development of this larva difficult and very limited during low temperatures.

Types of tunnel

The study showed through Figure (2) that the leaf miner has different forms of tunnels, as follows; Serpentine tunnel; the larvae dig in a straight line in the parenchymal cells of the leaf in one direction, with the head of the larvae facing forward. If the digging is in a crooked direction, the tunnel in this case is called a serpentine mine. (Parrella, 1987; Al-Hussainawy *et al*., 2021) indicated that female leaf miner, *L. bryoniae*, make two types of holes in the leaves: the first type (the fan hole) is used for feeding only, and the second type (the tubular hole) is used for both feeding and laying eggs as well.

Figure 2: *Different types of insects have different forms of tunneling on leaves.*

Wide tunnel

This occurs when the larva digs a wide area in the leaves and digs its way into the tunnel in multiple directions. Such a tunnel takes many forms. It may be circular, oblong, or lobed. The filamentous tunnel may expand and become wide, and in this case, it is called Linear blotch mine. In this case, the larva forms a filamentous tunnel after a while, making a wide tunnel. The location of the tunnel also varies in relation to the leaf. The location of the tunnel may be on the upper surface of the leaf or on the lower surface (Lee, 1990).

Conclusions and Recommendations

The study concluded that four species belonging to the Agromyzidae in Al-Muthanna Governorate infect twenty plants belonging to 11 plant families. The highest density of occurrence occurs during March and October. The infection rate during March has reached 90%, and the species create tunnels of various shapes on the plants.

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Novelty Statement

The research and experimental work on the subject title is original and new in the field of entomology science in Iraq.

Author's Contribution

Khalid J. Al-Hussainawy: Conceived the idea, designed the methodology, and wrote the first draft.
Dalal Tareq Al-Ameri: Assisted in writing the initial draft.

Generative AI or AI assisted technology statement

The authors declare that no generative AI was used in the creation of this manuscript.

Conflict of interest

The authors have no conflict of interest.

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