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## Population Dynamics of (*Liriomyza sativae*) Blanchard Diptera: and (*Agromyzidae*) and its Parasitoids on Climbing Crop Under (Plastic Greenhouse Conditions)

### ABSTRACT

The field study (under plastic greenhouse conditions) in the fields of the Agriculture College of - Tikrit University for the agricultural season 2018-2019 showed variation in the numerical density of the leafminer *Liriomyza sativae* (Blanchard) on Climbing bean *Phaseolus vulgaris* L. The effect of temperature and relative humidity were evident in their density, as the average number of *L. sativae* larvae reached 35.3 larvae / plant in the second week of December 2018, and reached their peak (62.8 larva / plant) in the first week of January 2019 when the temperature was 12.5 ° C and the relative humidity was 92%. Five species of parasitoids belonging to the order Hymenoptera have been recorded as parasitizing the larvae and pupae of the *L. sativae*. The species included *Hemiptarsenus varicornis*, *Halticoptera* sp., *Neochrysocharis* sp., *Chrysocharis parksii* and *Pnigalio* sp. During the season, the highest rate of parasitism was 12.68% during the month of January.

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### INTRODUCTION

Leafminers, which belong to the genus *Liriomyza*, are considered dangerous pest that attacks several plant families of economically important vegetable crops, including beans, tomatoes, potatoes, eggplant and ornamental plants, causing the reduction of the leaf area of leaves by feeding their larvae between the two surfaces of the leaves, which leads to damage to the intermediate tissues of the leaves and reduce their capacity. To accomplish the photosynthesis process due to the lack of its chlorophyll content, and thus yellowing and falling leaves, small fruits and low productivity, as well as the feeding holes and egg-laying holes that adults make in the leaf tissue, causing tissue death, and adults also transmit viral diseases (Al-Hayani, 2015).

Several researchers have indicated that leafminer *L. sativae* is a major pest for common beans, French beans, peas, tomato, cucumber, pumpkin and watermelon (Andersen et al., 2002; Fourouzan and Farrokh-Eslamloo, 2017), and *L. sativae* caused significant losses the vegetable crops range from 80-100% depending on the type of crop and the level of infestation (Chabi - Olaye et al. 2008). In Iraq, Al-Hayani (2015) identified four types of parasitoids belonging to the order Hymenoptera that parasitize on the larvae and pupae of bean and tomato leafminers (*L. sativae* and *L. bryoniae*) including *Pachyneuron grande*, *Halticoptera* sp, *Neochrysocharis* sp and *Chrysocharis parksii*. The aim of the present study was to survey and diagnose *Liriomyza sativae* parasitoids on the climbing bean under plastic greenhouse conditions.

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## MATERIALS AND METHODS

This study was conducted in the greenhouse complex of the Agriculture College / Tikrit University - Iraq for the 2018-2019 season:

### Preparing the greenhouse and planting it

The greenhouse which is 50 m in length, 9 m in width and 3.5 m in height and the house area is 450 m<sup>2</sup> was prepared. The soil was plowed using a tipping plow, and 2.5 m was left on both sides of the doors of the plastic house for ease of movement within the experiment field. Five floors were identified for cultivation inside the greenhouse, with a width of 60 cm for the bench and 1 m between The terraces, and adding the organic vegetable fertilizer Homobactra-A of Jordanian origin, at a rate of 25 kg / floor, and mixing it with the soil and constructing the terraces. The greenhouse was planted with Yagmur climbing beans produced by the Turkish company Simagro Agro and seed company.

### Sampling Program

A weekly program for field sampling was set up as the actual sampling program started from 11/25/2018 to 1/30/2019, as (5) plants were selected from each replicate randomly, with 2 leaves from the top of the plant, 2 leaves from the middle part and 2 leaves from the bottom. The leaves were placed in polyethylene bags labeled according to the variety and replicate, and brought to the laboratory to record the required data in special tables prepared for this purpose with the aim of:

#### First: To study the population dynamics of *L. sativae* during the infestation season

Through a weekly sampling program, the insect activity was studied over the infestation season on the climbing beans, and weekly temperature and relative humidity data were obtained by means of a thermo-hygrograph placed inside the plastic house during the season.

#### Second: Survey and taxonomy of *L. sativae* parasitoids

Through the weekly sampling program from the field of experiment, which lasted from 11/25/2018 to 30/1/2019, and in order to obtain the adults of the parasitoid for the purpose of their diagnosis, the part of the leaf containing the leafminer larva was cut with the parasitoid inside the mines only to avoid rotting, was placed in Durham glass tubes measuring (1 x 3) cm and then blocked the tubes with sterile medical cotton. All tubes were placed in an incubator at  $27 \pm 2$  ° C temperature and a relative humidity of  $68 \pm 2\%$ . The tubes were monitored daily until the adults of the parasitoids were released for taxonomy in the Natural History Museum - University of Baghdad.

## RESULTS AND DISCUSSION

### Population dynamics of *L. sativae* during infection season

This study was conducted throughout the season of infestation by bean leafminer for the period from the start of the first infection in October-2018 until the end of the bean season at the end of February 2019.

The results showed that the first record of the occurrence of infection by the bean leafminer *L. sativae* on bean plants in the greenhouse was on 5-11-2018 2018 with density of 2 larvae / Plant when temperature was 24 ° C and the relative humidity was 60% and its numerical density continued to increase until the average number of larvae reached 20.3 larvae / Plant at a temperature of 20.5 ° C and a relative humidity of 65% on 28 November-2018, and it reached its peak (62.8 larvae / plant) on 2 January-2019 when the temperature was 12.5 ° C and the relative humidity of 92%, then its numerical density began to decrease until it reached 40.8 larvae / Plant on (January 22nd) when the temperature reached 19 ° C and the relative humidity was 80% (Figure 1).

It is evident from the results that temperature and humidity are two determining factors for its numerical density and affect the life and reproduction of the insect inside the greenhouse as it was the best suitable conditions for the *L. sativae* at a temperature of 12.5 ° C and a relative humidity of 92%, and these results are in agreement with Al Hayyani (2015) It was found that the most favorable conditions for the *L. sativae* were at a temperature of 13.5 ° C and a relative humidity of 92%. Luo et al. (2004) indicated in his laboratory study that the high temperatures lead to shortening the life span of the *Liriomyza huidobrensis* adult and reduce their fertility, in addition, the survival rate of the incomplete stages of the larvae and pupae was reduced to 3.9% at a

temperature of 30 ° C, and all the larvae and pupae died at a temperature of 33 ° C, and consequently, the numbers of emerging adults decreased.

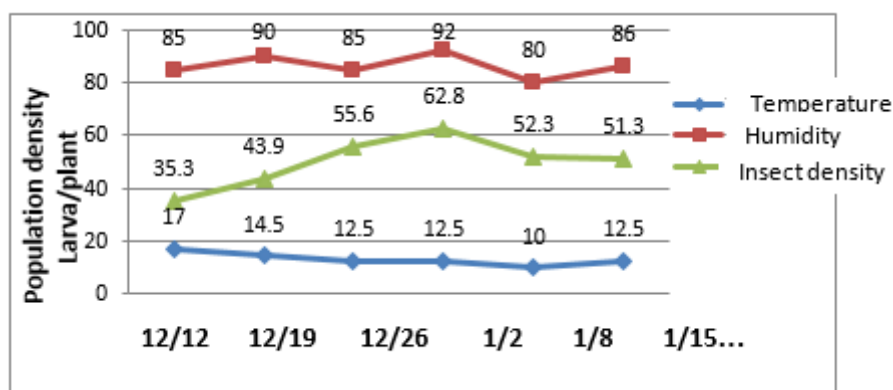


Fig (1) Population density of *L. sativae* during the season 2018-2019

#### Diagnosed parasitoids during season on incomplete stages of *L. sativae*

The study showed that the second and third larval ages (except for the first larval age), the *L. sativae*, was exposed to parasitism by parasitoids of hymenoptera, as five of them were isolated and diagnosed:

No.	parasitoid	Family	Order
1	<i>Hemiptarsenus varicornis</i>	Eulophidae	Hymenoptera
2	<i>Halticoptera</i> sp.	Pteromalidae	
3	<i>Chrysocharis parksi</i>	Eulophidae	
4	<i>Neochrysocharis</i> sp.	Eulophidae	
5	<i>Pnigalio</i> sp.	Eulophidae	

Through the study it was found that the external parasitoids female injects the toxin into the host's body by ovipositor before the egg laying process, which often leads to permanent paralysis of the larva to prevent its motion activity, physiological activity and development, and to prevent it from rotting. It showed as well that the females prefer the second and third instar larvae laying its egg on the body of the larva or near it, then the egg hatches from the first instar larva, which begins to feed from the end of the body of the leafminer larva with its development and moulting until it turns into pupa then it becomes an adult as in the parasitoid *Hemiptarsenus varicornis* and *Pnigalio* sp., while the endoparasitoid females may temporarily paralyze its host or may not paralyze it for the purpose of continuing the development of the egg that is placed inside the body of the leafminer, which hatches into a larva that feeds on fluids and amino acids in the blood of the larva without leading to its death. In the last larval age or the pupal stage of the leafminer, the larva of the last age of parasitoid attacks the internal organs of the larva or pupae and thus leads to its death, while the last instar larva of parasitoid turns into a pupa inside mummies, from which only the external cuticle remains until the parasitoid adult exits. As in endoparasitoids *Halticoptera* sp. and *Chrysocharis parksi*, which are both larva-pupa parasitoids and this is consistent with what Parrella and others (1982) and Gratton and Walter (2001).

Nagalingam et al. (2007) identified five parasitoids on leafminer *L. sativae* including *Diglyphus isaea*, *Hemiptarsenus varicornis*, *Closterocerus* sp. and *Optius* sp., while Wahyuni et al. (2017) found seven species of parasitoids on *Liriomyza* including *Neochrysocharis formosa*, *Hemiptarsenus varicornis*, *Opius chromatomyiae*, *Opius dissitus*, *Neochrysocharis okazakii*, *Asecodes deluchii*, *Gronotoma micromorpha*. Purnomo and Wright (2016) found two ectoparasitoids to parasitize on the potato leafminer larvae *Liriomyza huidobrensis*, namely *Hemiptarsenus varicornis* and *Diglyphus isaea*.

### Parasitism percentages on incomplete stages of leafminer *L. sativae*.

The results of the study (Figure 2) showed that the percentage of parasitism on the incomplete roles (larvae and pupae) of the *L. sativae* during November-2018 was 2.62%, then the parasitism rate increased with the increase in insect density to reach 4.81% during December. The parasitism rate reached the peak in January, reaching 12.68%.

These results are consistent with the findings of Al-Hayani (2015), who found that the parasitism percentage into incomplete stages reached a peak in January, reaching 3.03%.

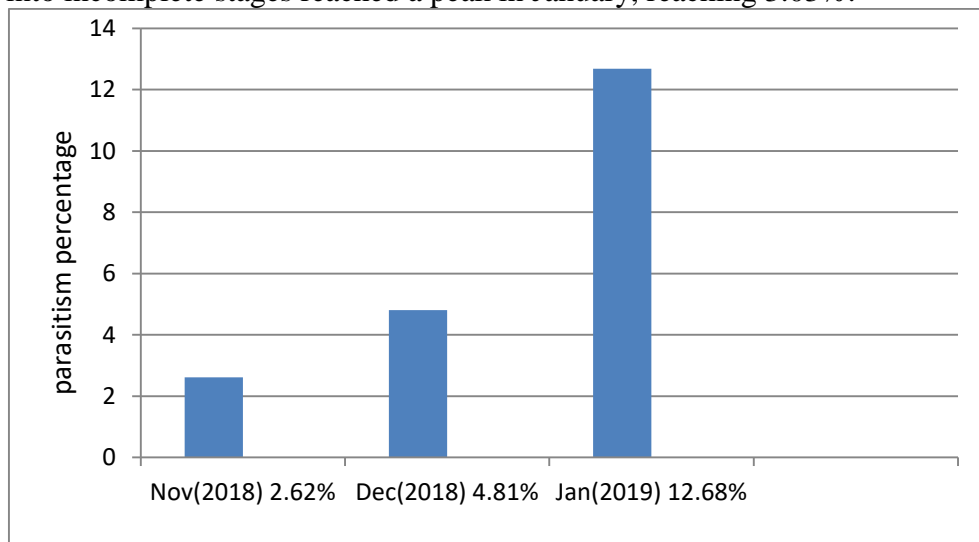


Fig (2) Parasitism percentages on incomplete stages of leafminer *L. sativae* 2018-2019

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ديناميكية سكان صانعة انفاق اوراق الخضر *Liriomyza sativae* (Diptera :Agromyzidae) وطفيلياتها على محصول اللوبيا المتسلقة تحت ظروف الزراعة البيت البلاستيكي

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#### الخلاصة

أظهرت الدراسة الحقلية (تحت ظروف تحت البيت البلاستيكي) تبايناً في الكثافة العددية لحشرة صانعة الانفاق *L. sativa* على محصول الفاصوليا المتسلقة *Phaseolus vulgaris* L.، إذ كان تأثير درجة الحرارة والرطوبة النسبية واضحاً في أعدادها ، حيث بلغ متوسط عدد اليرقات 35.3 يرقة / نبات في الأسبوع الثاني من شهر كانون الأول ، وبلغت ذروتها (62.8 يرقة / نبات) في الأسبوع الأول من شهر كانون الثاني. عندما كانت درجة الحرارة 12.5 درجة مئوية وكانت الرطوبة النسبية 92%. تم تسجيل خمسة أنواع من الطفيليات تنتمي إلى رتبة غشائيات الأجنحة على أنها تطفل على يرقات وعضاري *L. sativa* وشملت الأنواع *Hemiptarsenus varicornis* و *Halticoptera* sp. و *Neochrysocharis* sp و *Chrysocharis parksi* و *Pnigalio* sp. وبلغت أعلى نسبة تطفل خلال الموسم 12.68% خلال شهر كانون الثاني 2019.

#### الكلمات المفتاحية:

*Liriomyza sativae*، متطفلات ، ديناميكية سكان، فاصوليا متسلقة.