

Field Studies on the Pea Leaf Miner *Liriomyza huidobrensis* (Blanchard) and its Associated Ectoparasitoid *Diglyphus isaea* (Walker)

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ABSTRACT

A field study was carried out at the experimental farm of Sakha Agricultural Research station, Kafr El-Sheikh, Egypt during two seasons 2015/2016 and 2016/2017. The highest peak of abundance of *L. huidobrensis* total larvae on *Pisum sativum* plants recorded in the third week of December 2015 and represented by 62 larvae /100 leaflets. The highest peak for healthy larvae found in the third week of March 2016 and represented by 51 larvae. While the highest peak of abundance for the parasitized *L. huidobrensis* larvae by *D. isaea* found in the second week of January 2016 and represented by 16 larvae, and unknown larval mortality recorded in the fourth week of December 2015 and represented by 11 larvae. The average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality were recorded with an average of 27.3 ±1.7, 30.4 ±1.7, 4.1 ±0.11 and 3.5 ±0.6 larvae, respectively. The average percentage of the healthy larvae recorded 73.3% and the average percentage of parasitism caused by *D. isaea* was 14.5% while, the percentage of unknown larval mortality recorded 9.6% during the first season 2015/16. The highest peak of abundance of *L. huidobrensis* total larvae on *Pisum sativum* plants recorded in the second week of January 2017 and represented by 70 larvae /100 leaflets. The highest peak for healthy larvae found in the third week of December 2016 and represented by 41 larvae. While the highest peak of abundance for the parasitized *L. huidobrensis* larvae by *D. isaea* found in the second week of January and represented by 16 larvae, and unknown larval mortality recorded in the second week of January 2017 and represented by 21 larvae. The monthly average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality were recorded with an average 28, 18.4, 2.9 and 6.6, respectively. The average percentage of the healthy larvae recorded 76.2% and the average percentage of parasitism caused by *D. isaea* was 6.6% while, the percentage of unknown larval mortality recorded 17.3% during the second season 2016/17.

INTRODUCTION

Pea, *Pisum sativum* L. represents one of the most important popular foods, having high nutrients values of human consumption, either as green pods or dry seeds. This crop is liable to be attacked by several insect pests from the early stage of growth through late of development to the harvest stage. Pea leaf miner *Liriomyza huidobrensis* (Blanchard), is an important agricultural pest and highly polyphagous leafminer and has hosts in at least 15 plant families (Foba *et al.*, 2015). They found that *L. huidobrensis* was the most abundant across all altitudes irrespective of the cropping season and accounting for over 90% of the total *Liriomyza* specimens collected from four crops. *L. huidobrensis* had the widest host range (20 crops) and dominant at all altitudes.

The effective biological control of *Liriomyza spp.* by the hymenopterous parasitoids may depend on matching the most effective parasitoid species complex with *Liriomyza spp.* and crop (Johnson and Hara, 1987). The larval ectoparasitoid, *Diglyphus isaea* Walker was the most important parasitoids of this pest which causes the greatest larval mortality (Carballo *et al.*, 1990) and (Beitia *et al.*, 1991). The parasitoid females discriminated healthy hosts and those which had been previously attacked. (Coaker and Cheah, 1993). Leuprecht (1991) reported that the most abundant biological control agents against the agromyzid *L. huidobrensis* on vegetable crops in Bavaria, are the parasitoids *Diglyphus sp.* and *Opius sp.* Sha *et al.* (2007) mentioned that *D. isaea* is a primary parasitoid of Agromyzid leaf miner and has been commercialized as a biological control agent. Therefore, this study was carried out to investigate the population abundance of *L. huidobrensis* larvae on *Pisum sativum* and the seasonal activity of *L. huidobrensis* parasitoids.

MATERIALS AND METHODS

The present study was conducted at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh during two successive seasons, 2015/16 and 2016/17 on an area about 200m² for each season and divided into four equal replicates each replicate 50m. Pea sown in the last week of October in both seasons. All recommended agricultural practices were applied during the growing season without insecticides applications.

Samples started one month after sowing dates and continued weekly until harvest. Each sample comprised 100 leaflets from the four replicates (each replicate 25 leaflets) picked separately and randomly from the upper, middle and lower parts of Pea plants. Collected samples were transferred to the laboratory for examination. Number of the total *L. huidobrensis* larvae, healthy larvae, parasitized larvae and unknown mortality larvae were counted and recorded weekly.

RESULTS AND DISCUSSION

The total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the first season 2015/16:

The obtained results illustrated in Fig. (1) showed the total larvae of *L. huidobrensis* on *Pisum sativum* plants during the first season 2015/16. The number of the total larvae of *L. huidobrensis* began with 17 larvae/ 100 leaflets in the last week of November 2015, then increased gradually to reach the highest peak with 62 larvae in the third week of December 2015.

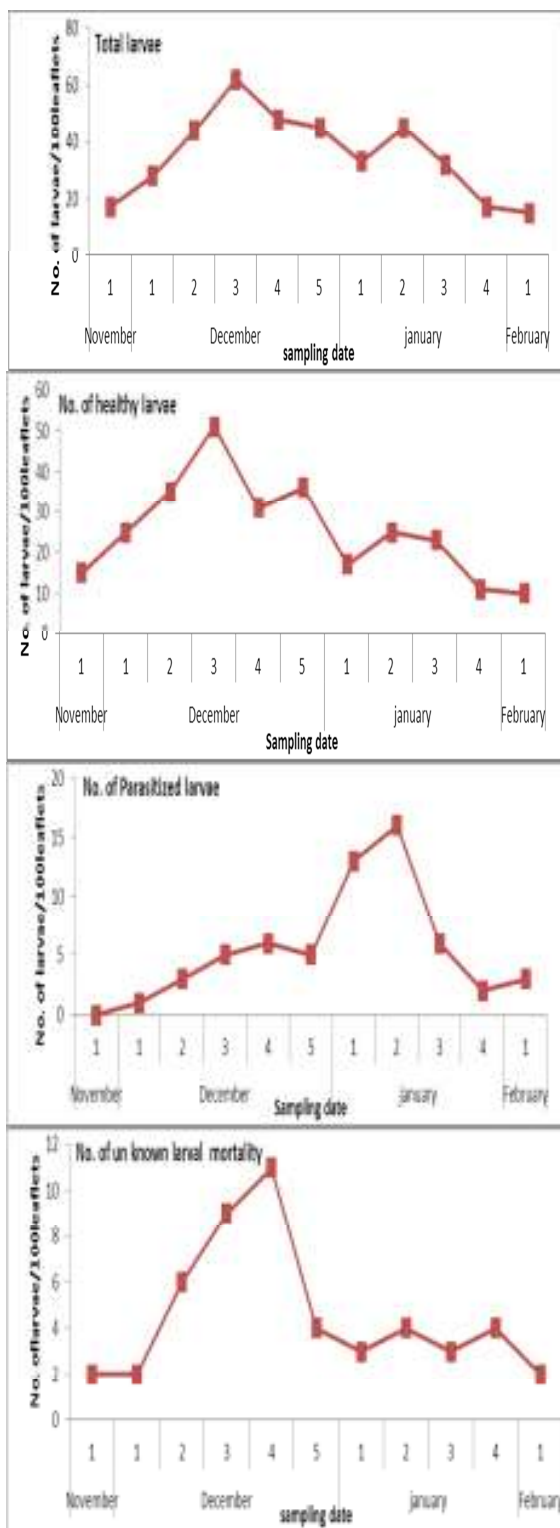


Fig. 1 The total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the first season 2015/16 in Kafr El-Sheikh region

The number of the healthy larvae of *L. huidobrensis* on *P. sativum* plants began with 15 larvae

in the Last week of November 2015 and then increased gradually to reached the highest peak with 51 larvae in the third week of December 2015. While the number of the parasitized larvae of *L. huidobrensis* by *D. isaea* began with one larvae in the first week of December 2015, then increased gradually to reached the highest peak with 16 larvae in the second week of January 2016. Moreover, the number of unknown larval mortality of larvae began with 2 larvae in the fourth week of November 2015 and increased gradually to reached the highest peak with 11 larvae in the fourth week of December 2015.

As a conclusion, during the first season 2015/16 the highest peak of abundance of *L. huidobrensis* total larvae on *Pisum sativum* plants recorded in the third week of December and represented by 62 larvae /100 leaflets. The highest peak for healthy larvae found in the third week of December and represented by 51 larvae. While the highest peak of abundance for the parasitized *L. huidobrensis* larvae by the ectoparasitoid *D. isaea* found in the second week of January and represented by 16 larvae and unknown larval mortality recorded in the fourth week of December and represented by 11 larvae.

Monthly average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown mortality during season 2015/2016:

Results in Table (1) showed that The highest monthly average number of the total larvae, healthy larvae and unknown larval mortality of *L. huidobrensis* were recorded in December 2015 with an average 45.4, and 6.4 larvae ,respectively and parasitized larvae by *D. isaea* was recorded in January 2016 with an average 9.3 larvae.

As a conclusion, data in Table (1) indicated that monthly average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality were recorded with an average of 27.3 ±1.7, 19.9 ±1.7, 4.1 ±0.11 and 3.5 ±0.6, respectively.

Monthly percentage of the healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the first season 2015/16:

The obtained results illustrated in Table (2) showed the monthly percentage of the healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the first season 2015/16. It can be noticed that the percentage of the healthy larvae of *L. huidobrensis* ranged between 66.7% in February 2016 and 59.7% in January 2016. On the other hand the percentage of the parasitized larvae by *D. isaea* of *L. huidobrensis* ranged between 0.0% in November 2015, and 29.2% in January 2016. While the percentage of the unknown larval mortality of *L. huidobrensis* ranged between 0.1% in November 2015, and 14.1% in December.

As a conclusion, the average percentage of the healthy larvae recorded 73.3% and the average percentage of parasitism caused by *D. isaea* was 14.5% while, the percentage of unknown larval mortality recorded 9.6% during the first season 2015/16.

Table 1. Monthly average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown mortality during season2015/2016:

Months	Total larvae	Healthy larvae	Parasitized larvae	unknown larval mortality
November	17.0	15.0	0.0	2.0
December	45.4	35.6	4.0	6.4
January	31.8	19.0	9.3	3.5
February	15.0	10.0	3.0	2.0
Mean	27.3 ±1.7	19.9 ±1.7	4.1 ±0.11	3.5 ±0.6

Table 2. Monthly percentage of the healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the first season 2015/16:

Months	Healthy larvae	Parasitized larvae	unknown larval mortality
November	88.2	0.0	0.1
December	78.4	8.8	14.1
January	59.7	29.2	11.0
February	66.7	20.0	13.3
Mean	73.3	14.5	9.6

The total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the second season 2016/17:

The obtained results illustrated in Fig. (2) showed the total larvae of *L. huidobrensis* on *p. sativum* plants during the second season 2016/17. The number of the total larvae of *L. huidobrensis* began with 18 larvae/ 100 leaflets in the Last week of November 2016, then increased gradually to reached the highest peak with 70 larvae in the second week of January 2017; The number of the healthy larvae of *L. huidobrensis* on *p. sativum* plants began with 15 larvae in the last week of November 2016, then increased gradually to reached the highest peak with 41 larvae in the third week of December 2016. While the number of the parasitized larvae of *L. huidobrensis* by *D. isaea* began with one larvae in the first week of December 2016, then increased gradually to reached the highest peak with 16 larvae in the second week of January 2017. Moreover, the number of unknown mortality of larvae began with 3 larvae in the Last week of November 2016, and increased gradually to reached the highest peak with 21 larvae in the second week of January 2017.

As a conclusion, during the second season 2016/17 the highest peak of abundance of *L. huidobrensis* total larvae on *p. sativum* plants recorded in the second week of January 2017 and represented by 70 larvae /100 leaflets. The highest peak for healthy larvae found in the third week of December 2016 and represented by 41 larvae. While the highest peak of abundance for the parasitized *L. huidobrensis* larvae by the ectoparasitoid *D. isaea* found in the second week of January and represented by 16 larvae. and unknown larval mortality recorded in the second week of January and represented by 21 larvae.

Monthly average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality 2016/2017:

Results in Table (3) showed that The highest monthly average of the number of the total larvae and the healthy larvae were recorded in December 2016 with an average 45.3, and 30.8, respectively while The highest monthly average of the number of the parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* were recorded in January 2017 with an average 7.0 and 13.8, respectively.

Data in Table (3) indicated that the average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* un known larval mortality were recorded with an average 28±2.3, 18.4±2.3, 2.9±0.3 and 6.6±0.6 ,respectively.

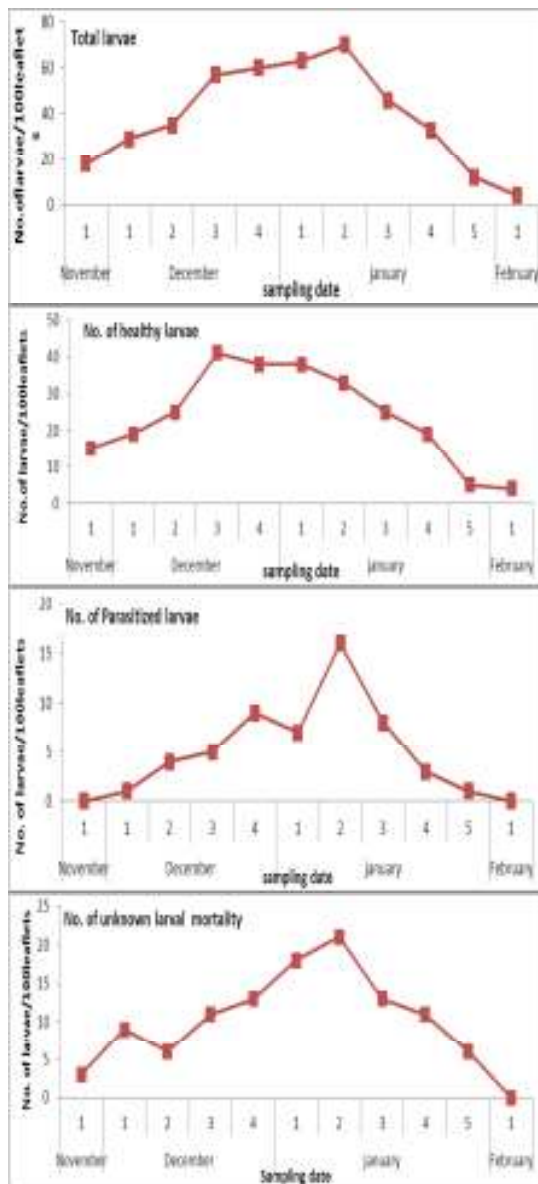


Fig 2. The total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the second season 2016/17.

Table 3. Monthly average number of the total larvae, healthy larvae, parasitized larvae by *D. isaea* and unknown mortality on *Pisum sativum* plants 2016/2017:

Months	Total larvae	Healthy larvae	Parasitized larvae	unknown larval mortality
November	18.0	15.0	0.0	3.0
December	45.3	30.8	4.8	9.8
January	44.8	24.0	7.0	13.8
February	4.0	4.0	0.0	0.0
Mean	28±2.3	18.4±2.3	2.9±0.3	6.6±0.6

Monthly percentage of the healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the second season 2016/17:

The obtained results illustrated in Table (4) showed that the percentage of the healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the second season 2016/17. It can be noticed that the percentage of the healthy larvae of *L. huidobrensis* ranged between 53.6% in January 2017 and 100% in February 2017. On the

other hand the percentage of the parasitized larvae by *D. isaea* of *L. huidobrensis* ranged between 0.0% in November 2016, and February 2017 and 15.6% in January 2017. While the percentage of the unknown larval mortality of *L. huidobrensis* ranged between 0.0% in February 2017, and 30.8% in January 2017.

As a conclusion, the average percentage of the healthy larvae recorded 76.2% and the average percentage of parasitism caused by *D. isaea* was 6.6% while, the percentage of unknown larval mortality recorded 17.3% during the second season 2016/17

Table 4. Monthly percentage of the healthy larvae, parasitized larvae by *D. isaea* and unknown larval mortality of *L. huidobrensis* during the first season 2015/16:

Months	Healthy larvae	Parasitized larvae	unknown larval mortality
November	83.3	0.0	16.7
December	68.0	10.6	21.6
January	53.6	15.6	30.8
February	100.0	0.0	0.0
Mean	76.2	6.6	17.3

These results are agreement with those of Bahlai et al. (2006) they found that members of three families of hymenopteran parasitoids of *L. huidobrensis* were identified: *Chrysocharis oscinidis* Ashmead (Eulophidae), *Halticoptera circulus* (walker) (Pteromalidae and Braconidae) *Dacnusa spp.* And *Opius sp.* They indicated that mortality and parasitism rates of Pea leafminer pupae were higher in 2002 than 2003 and varied according to host plant. Parasitism ranged from 4 to 27% in 2002 and 4 to 13% in 2003. The parasitoid complex differed among host plants on which parasitoids were found to parasitize Pea leafminers El-Khawas (2012) determined the percentages of parasitism of the leafminer *L. trifolii* attacking *Pisum sativum* (nili plantation), he showed that the parasitoid *D. isaea* was the most abundant recorded parasitoid species of the pest. Foba et al. (2015) showed that three main species of *Liriomyza* leafminer were identified: which *L. huidobrensis* (Blanchard) *L. trifolii* (Burgess) and *L. sativae* (Blanchard). *L. huidobrensis* had the widest host range (20 crops) followed by *L. sativae* (18 crops) and *L. trifolii* (12 crops). Also, *L. huidobrensis* was the most abundant across all altitudes irrespective of the cropping season and accounting for over 90% of the total *Liriomyza* specimens collected. Leuprecht (1991) reported that the most abundant biological control agents against the agromyzid *L. huidobrensis* on vegetable crops in Bavaria, are the parasitoids *Diglyphus sp.* and *Opius sp.* Sha et al. (2007) mentioned that *D. isaea* is a primary parasitoid of Agromyzid leaf

miner and has been commercialized as a biological control agent. Goncalves and Anunciada (2001) in Portugal, studied the population density of the parasitoids *D. isaea* and *D. poppoea* Walker on *L. trifolii* and *L. huidobrensis* Blanchard and *Phaseolus vulgaris* L. in greenhouse during three successive seasons. They found that *D. isaea* was the most dominant parasitoid. It was always above 60% whereas 38.9 was the maximum population reached by *D. poppoea*.

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دراسات حقلية علي صانعه انفاق البسلة (*Liriomyza huidobrensis* (Blanchard) و الطفيل الخارجي المرتبط بها *Diglyphus isaea* Walker

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اجريت هذه الدراسه الحقلية بالمزرعه البحثيه لمحطه البحوث الزراعيه بسخا - كفر الشيخ خلال موسمين ٢٠١٦/٢٠١٥، سجلت اعلي قمه لوفره التعداد الكلي ليرقات صانعه انفاق البسلة *L. huidobrensis* علي نبات البسلة في الاسبوع الثالث من ديسمبر ٢٠١٥ وتواجدت بتعداد ٦٢ يرقة/١٠٠ وريقه واعلي قمه لليرقات السليمه وجدت في الاسبوع الثالث من مارس ٢٠١٦ بتعداد ٥١ يرقة. بينما اعلي قمه لوفره اليرقات المتطفل عليها بالطفيل *D. isaea* , وجدت في الاسبوع الثاني من يناير ٢٠١٦ بعدد ١٦ يرقة و اليرقات غير معروف اسباب موتها سجلت في الاسبوع الرابع من ديسمبر ٢٠١٥ بتعداد ١١ يرقة * تم تسجيل متوسط التعداد الكلي لليرقات و اليرقات السليمه و اليرقات المتطفل عليها بالطفيل *D. isaea* , واليرقات غير معروف اسباب موتها بالمتوسطات ١.٧+٢٧.٣ , ١.٧+٣٠.٤ , ٠.١١+٤.١ , ٠.٦+٣.٥ , يرقة علي التوالي. * النسبة المئوية لليرقات السليمه سجلت ٣٧.٣% والنسبة المئوية للتطفل بواسطه الطفيل *D. isaea* بلغت ١٤.٥% بينما نسبة اليرقات غير معروف اسباب موتها سجلت ٩.٦% خلال الموسم الاول ٢٠١٦/٢٠١٥. * سجلت اعلي قمه لوفره التعداد الكلي ليرقات صانعه انفاق البسلة *L. huidobrensis* علي نبات البسلة في الاسبوع الثاني من يناير ٢٠١٧ بعدد ٧٠ يرقة / ١٠٠ وريقه. واعلي قمه لليرقات السليمه وجدت في الاسبوع الثالث من ديسمبر ٢٠١٦ بعدد ٤١ يرقة. بينما اعلي قمه لوفره اليرقات المتطفل عليها بالطفيل *D. isaea* , وجدت في الاسبوع الثاني من يناير ٢٠١٧ بعدد ١٦ يرقة. واليرقات غير معروف اسباب موتها في الاسبوع الثاني من يناير ٢٠١٧ بعدد ٢١ يرقة * متوسط التعداد الكلي لليرقات –اليرقات السليمه –اليرقات المتطفل عليها بالطفيل *D. isaea* – اليرقات غير معروف اسباب موتها سجلت بمتوسطات ٢٨ , ١٨.٤ , ٢.٩ , ٦.٦ , يرقة عتي التوالي.* بلغ متوسط النسبة المئوية لليرقات السليمه ٧٦.٢% , ومتوسط النسبة المئوية للتطفل بالطفيل *D. isaea* , بينما متوسط ٦.٦% بينما متوسط النسبة المئوية لليرقات الغير معروف اسباب موتها سجل ١٧.٣% خلال الموسم الثاني ٢٠١٧/٢٠١٦.