

Original Research Article

**Population abundance of the ectoparasitoid
Diglyphus isaea Walker (Hymenoptera:
Eulophidae) on the serpentine leaf miner
Liriomyza bryonia. (Diptera: Agromyzidae) On
some summer host plants in Ojilate region,
Libya**

ABSTRACT

Natural abundance of the ectoparasitoid *Diglyphus isaea* walker was studied on three summer host plants [tomatoes (*Solanum lycopersicum*), Bell peppers (*Capsicum annum*), egg plants (*Solanum melongena*)] in Ojilate region. The parasitoid showed low populations in April on all studied host plants. Then developed high populations in May and June , the population decreased till the end of the growing season.

D. isaea recorded 2-3 peaks of abundance on all studied host plants, the highest peak recorded 36, 29, and 16 individuals/ 50 infested leaflets on tomatoes, eggplant, and bell pepper respectively . The highest average numbers in June on tomatoes recording 26.25 ± 3.86 , in may on eggplants recording 20.25 ± 6.50 , and in June on bell pepper recording (20.25 ± 6.50) individuals/ 50 infested leaflets). On the other hand the monthly average percentages of parasitism recorded its highest numbers in may recording $(45.71 \pm 27.66, 41.04 \pm 25.13)$ on tomatoes and eggplants and 25.19 ± 11.19 on bell pepper.

Keywords: *Diglyphus isaea*, abundance, host plants

1. INTRODUCTION

Genus *Liriomyza* contains more than 300 species, widely distributed in the new and old world but are commonly found in temperate areas [1]. *Diglyphus* spp. Are the most important leafminer larval parasitoids. *Diglyphus begini* (Ashmead), *D. intermedius* (Girault) and *D. isaea* (Walker) were found parasitizing leafminer larvae on cultivated and spontaneous plants [2]. *L. bryoniae* is a highly polyphagous species and important primary hosts of economic importance include: cabbages (*Brassica oleracea* var. *capitata*), cucumbers (*Cucumis sativus*), lettuces (*Lactuca sativa*), courgettes (*Cucurbita pepo*), melons (*Cucumis melo*), tomatoes (*Lycopersicon esculentum*) and watermelons (*Citrullus lanatus*) [3]. In the pan-temperate region, *L. bryoniae* has been reported to complete its life cycle on plants from 16 families [4]. *Diglyphus isaea* is a primary parasitoid of agromyzid leaf miners and has been commercialized as biological control agent [5]. This species is a primary ectoparasitoid capable of developing on at least 18 different agromyzid species [6]. Minkenberg & van Lenteren, [7] describe *D. isaea* as being associated with *Liriomyza* hosts in herbaceous plants but scarce in trees. *Diglyphus isaea* has certainly been used as a biological control agent in a wide range of crops, whilst in the wild, populations of *D. isaea* have been found to use at least 14 species of weedy plant in northern Italy [8]. *Diglyphus isaea* has been used as a biological control against *L. bryoniae* since the mid-1980s [9].

Diglyphus isaea Walker was the most dominant parasitoid species against *L. trifolii* of the parasitoid complex which contained *Opius pallipes* Wesmeal and *Chrysocharis parksi* Crawford (Hymenoptera: Eulophidae) as an endoparasitoids [10]. **Ozawa et al.** [11] found that the dominant parasitoid species emerging from *L.trifolii* larvae in Homaoka tomato greenhouses was *D.isae*.This parasitoid was released in tomato greenhouses to control *L.trifolii* at different release doses , the percentage of parasitism ranged 94.1-100% by the end of the growing season. **Goncalves and Almeida** [12] reported that through a survey started in 1993 in several protected crops, two ectoparasitoids of *Liriomyza* spp, *D. isaea* and *D. poppoe* have been found every year, reaching rate of parasitism of 80-85% with predominance of the first one. Among the parasitoid complex of *Liriomyza* spp.in the Iranian fauna which contained several parasitoid species, the Eulophid *D.isaea* was the most common one [13].

From the available literature , few authors have studied the role of the parasitoid *D.isaea* as biocontrol agent against *L. trifolii* Therefore the present investigation was undertaken to study the role of the parasitoid *D.isaea* on *L. trifolii* on economic hosts under the Libyan condition.

2. MATERIAL AND METHODS

The present study was carried out in Ojilat region. Three summer host plants were targeted for this study plants [tomatoes (*Solanum lycopersicum*), Bell peppers (*Capsicum annuum*), egg plants (*Solanum melongena*)] fifty leaflets infested with *L. bryoina* were taken from each plant . Samples were kept in plastic bags and transferred to be examined in the laboratory .Number of living *L. bryoina* larvae , immature stages of the ectoparasitoid *D. isaea* were counted and recorded . Normal agricultural practices of fertilizing and irrigation were followed and no chemical control measurements were applied . Samples took place one weak after nurslings were replanted and continued weekly until harvest.

3. RESULTS AND DISCUSSION

Data presented in fig (1)shows the numbers of the ectoparasitoid *D. isaea* and the percentage of parasitism on three summer host plants .

On tomatoes the parasitoid *D. isaea* recorded low numbers in the beginning of the season in early December, then the population increased recording four peaks of abundance (19 ,28 ,36, and 30 individuals/ 50infested leaflets) occurred on 22th of April , 6th of May ,27th of May and the 24th of June respectively. On the other hand the percentage of parasitism ranged between 9.09 and 44.61% .

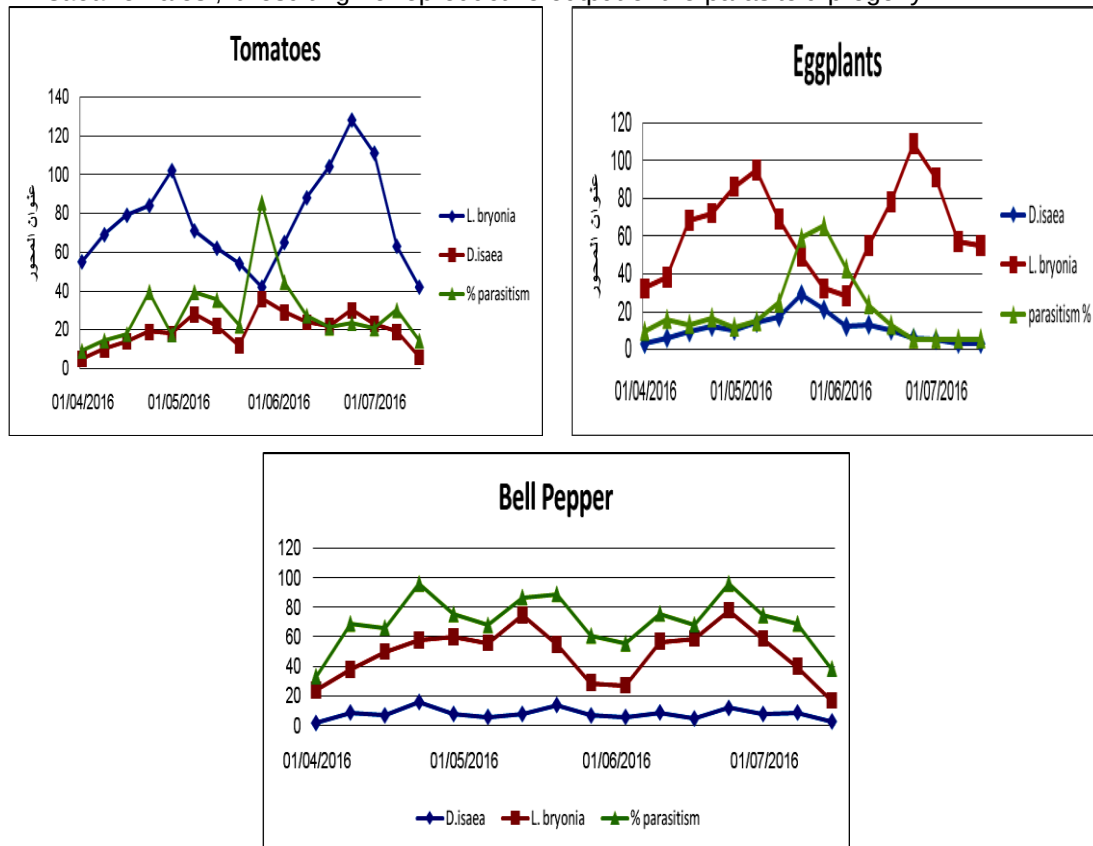
On eggplants the population of *D. isaea* recorded three peaks of abundance (14, 29, and 17 individuals/50 infested leaflets) occurred on 6^h of may , 20th of may , and 10th of june respectively , while the percentage of parasitism ranged between 5.26 and 59.18%

On Bell peppers pepper , the population of *D. isaea* recorded three peaks of abundance (16 , 14 and 12 individuals/50 infested leaflets) occurred in 22th of April , 20th of may and 24th of June respectively , while the percentage of parasitism ranged between 9.09 and 85.71% .

It could be concluded that , the percentage of natural parasitism by *D. isaea* reached more than 38% in all studied host plants thus , so it seems to be a very effective natural antagonist on the tomato leaf miner *L. bryonia* . **Elkhouly** [14] found that the percentage of parasitism by *D. isaea* in tomato greenhouses ranged between 10.3 and 55.3% when no release treatments were applied . Studies by **Awadalla et al.** [15] and **Khouly**, [10] revealed that *D. isaea* had high rates of parasitism on *L.trifolii* in open fields .they indicated that the parasitoid slightly preferred broad bean and fenugreek than sour clover as a winter host plant.

As shown in figure(2) the parasitoid *D. isaea* showed its highest average numbers in June on tomatoes recording 26.25±3.86 , in may on eggplants recording 20.25±6.50,and in june on bell pepper recording (20.25±6.50individuals/ 50 infested leaflets). On the other hand the

88 monthly average percentages of parasitism recorded its highest numbers in may recording
 89 (45.71±27.66, 41.04±25.13) on tomatoes and eggplants and 25.19±11.19 on bell pepper.
 90 These results show that that the larval ectoparasitoid, *D. isaea* recorded highest average
 91 numbers in June and may when its host *L. bryonia* reached high population because *D.*
 92 *isaea* prefers the high population of its host [16]. Data presented by **EL Khouly, [14]**
 93 showed that *D. isaea* females killed 21.3±4.7% of *L. trifolii* larvae 9.6±3.7% of them were
 94 host fed and 12.3±3.6% larvae were oviposited . So these results are in agreement with his
 95 finding . Another supporting results were presented by **Patel et al. [17]** who found that the
 96 parasitoid *Diglyphus intermedius* kills more hosts than it parasitize . In earlier study, **Heinz**
 97 **and Parrella [18]** observed that *Diglyphus begini* killed 1.3 *L. trifolii* larvae fore every larva
 98 used for oviposition . Eventually , despite host – feeding is an effective killing behavior
 99 against agromized larvae which supporting in combination with oviposition the efficiency of
 100 *D. isaea* females , it resulting no reproductive output of the parasitoid progeny.



Fig(1) Population abundance of the ectoparasitoid *D. isaea* and percentage of parasitism on three summer host plants in Ojilate region during the growing season 2016.

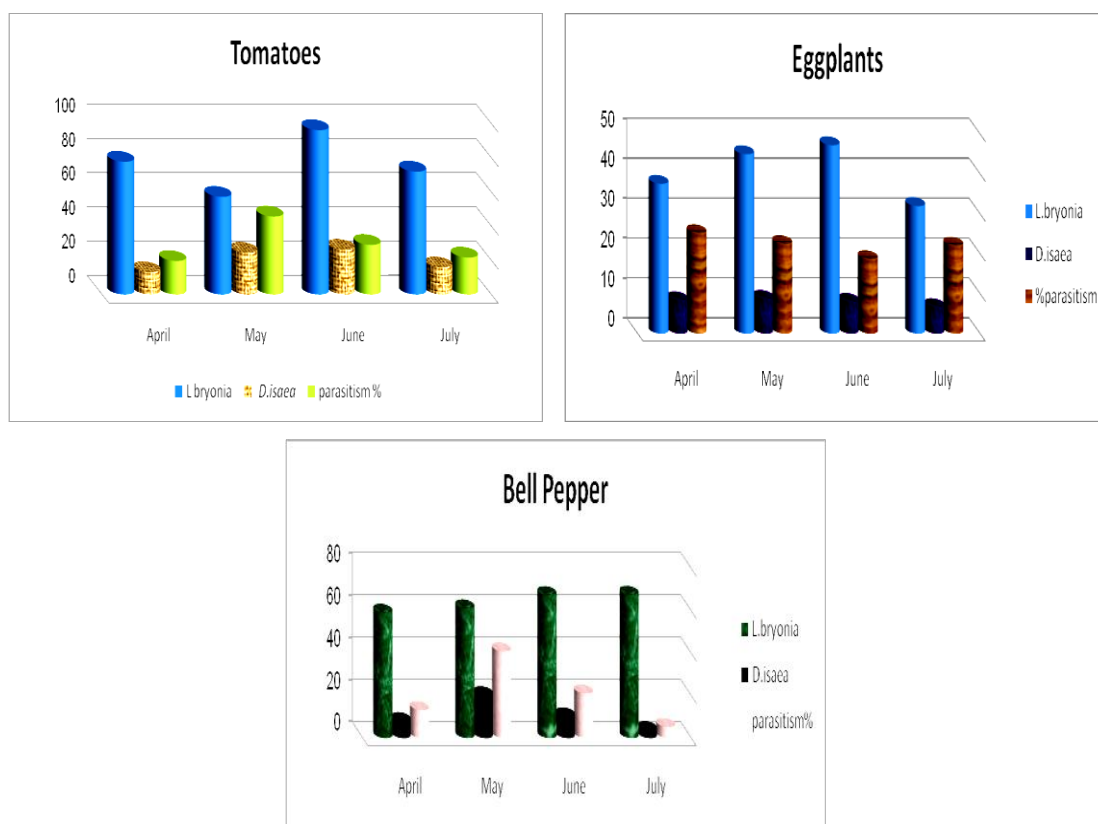


Fig (2) Monthly average numbers of the tomato leafminer *L. bryonia* and the larval ectoparasitoid *D. isaea* on three summer host plants.

REFERENCES

- [1] Parella, M.P. (1987). Biology of *Liriomyza*. Annu. Rev. Entomol., 32:301-224.
- [2] Carvalho A R , VHP Bueno , Db Silvara And VA Costa (2017) Record of *Diglyphus* Walker (Hymenoptera: Eulophidae) Species in Brazil. Neotropical Entomology. ISSN: 1519-566X
- [3] Abul-Nasr, S.; Assem, A.H. (1961) A leaf miner, *Liriomyza bryoniae* Kalt), attacking cucurbitaceous plants in Egypt. *Bulletin of the Entomological Society of Egypt* 45, 401-403.
- [4] Spencer.K.A.(1973). Agromyzidae (Diptera) of economic importance .Series. Entomol. 9: 1-4, Junk.The Hague.
- [5] Sha, Z.L; C.D. Zhu; R.W. Murphy and D.W. Huang (2007). *Diglyphus isaea* (Hymenoptera:Eulophidae): A probable complex of cryptic species that forms an important biological control agent of agromyzid leaf miners. J. Zool. Syst. Evol. Res., 45(2): 128-135.

- 118 [6] Boucek, Z. and R.R. Askew (1968). Hym. Chalcidoidea. Palearctic. Eulophidae (excl.
119 Tetrastichinae). Le Francois ,Paris.254pp.
- 120 [7] Minkenberg, O.P.J.M. and J.C. Van- Lenteren (1987). Evaluation of parasitic wasps for
121 biological control of leaf miners, *Liriomyza* sp. , in greenhouses. Bull. OILB / SROP 10:
122 115 – 120.
- 123 [8] Burgio G., Lanzoni A., Navone P., Van Achterberg K., and Masetti A. Parasitic
124 Hymenoptera fauna on agromyzidae (Diptera) colonizing weeds in ecological
125 compensation areas in northern Italian agroecosystems,” Journal of Economic
126 Entomology, 2007; 100(2): 298-306.
- 127 [9] Malais, M. H., & Ravensberg, W. J . (2003). Knowing and Recognizing The biology
128 of glasshouse pests and their Natural enemies (2nd ed.). The Netherlands :
129 Koppert B.V. Reed Bussiness Information.
- 130 [10] El.Khouly, A.R. (2003). Studies on some natural enemies associated with the serpentine
131 leaf miner *Liriomyza trifolii* (Burgess). M. Sc. Thesis, Fac., Agric., Mansoura univ.
132 pp.116
- 133 [11]Ozawa A., Saito T., and Ota M. Biological control of the American serpentine leafminer,
134 *Liriomyza trifolii* (Burgess), on tomato in greenhouses by parasitoids. II. Evaluation of
135 biological control by *Diglyphus isaea* (Walker) and *Dacnusa siberica* Telenga
136 in commercial greenhouses,” JPN J A ENT, 2001; 45(2): 61-74.
- 137 [12] Goncalves, M.A. and L. Almeida (2005). Biology of two parasitoids of leaf miners
138 *Liriomyza* spp, *Diglyphus isaea* and *D. poppoea* in southern portugal. J. Food .Agric.
139 Environ., 3(2):154-156 .
- 140 [13] Asadi, R.; A.A. Talebi; Y. Fathipour; S. Moharramipour and E. Rakhshani (2006).
141 Identifcation of parasitoids and seasonal parasitism of Agromyzid leaf miners genus
142 *Liriomyza* (Dip: Agromyzidae) in Varamin. Iran. J. Agric. Sci. and Tech., 8(4):293-303 .
- 143 [14] El.Khouly, A.R. (2009). Efficiency of some hymenopterous parasitoids on serpentine leaf
144 miner *Liriomyza trifolii* (Burgess). PhD. Thesis, Fac., Agric., Mansoura univ. 185 pp.
- 145 [15] Awadalla, S.S.; L.M. Shanab*; A.I. Abd El-Kareim; M.S. El-Nagar and E.R. El-Khouly
146 (2009). Host plant preference of the ectoparasitoid *Diglyphus isaea* Walker
147 (Hymenoptera: Eulophidae). J.Agric. Mansoura Univ., 34(1):505-510.
- 148 [15] Awadalla, S.S.; L.M. Shanab; A.I. Abd El-Kareim; M.S. El-Nagar and E.R. El-Khouly
149 (2009). Host plant preference of the ectoparasitoid *Diglyphus isaea* Walker
150 (Hymenoptera: Eulophidae). J.Agric. Mansoura Univ., 34(1):505-510.
- 151 [16] Linden, A. (1993). Biological control of leaf miners in glasshouse lettuce. "*Liriomyza*".
152 Conference on leaf mining flies in cultivated plants. Montpellier- France (March1993).
- 153 [17] Patel , K.J ; D.J Schuster and G.H .Smerage (2005) . Density dependant parasitism and
154 host- killing of *Liriomyza trifolii* (Diptera : Agromyzidae) by *Diglyphus intermedius*
155 (Hymenoptera : Eulophidae) Fla . Entomol. 86: 8-14.

- 156 [18] Heinz, K.M. and M.P. Parrella (1990). Holarctic distribution of the leaf miner parasitoid
157 *Diglyphus begini* (Hymenoptera : Eulophidae) and notes of its life history attacking
158 *Liriomyza trifolii* (Diptera : Agromyzidae) in Chrysanthemum . Ann. Entomol. Soc
159 .America, 83 (5):916-924.