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Natural Abundance of the Larval Ectoparasitoid *Diglyphus isaea* Walker (Hymenoptera: Eulophidae) on the Tomato Leaf Miner *Liriomyza bryonia*. (Diptera: Agromyzidae) On Some Summer Host Plants in Ojilate Region, Libya

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Authors' contributions

This work was carried out in collaboration between all authors. Author ARE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors EAAH, MME and HAS managed the analyses of the study. Author HAS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Natural abundance of the larval ectoparasitoid *Diglyphus isaea* walker was estimated on three summer host plants [tomatoes (*Solanum lycopersicum*), Bell peppers (*Capsicum annuum*), eggplants (*Solanum melongena*)] in Ojilate region. The parasitoid recorded low abundance in April on all studied host plants. Then developed high populations in May and June, the population then decreased by the end of the successive season.
The parasitoid *D. isaea* showed 2-3 peaks of abundance on all investigated host plants, the

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highest one recorded 36, 29, and 16 individuals/ 50 infested leaflets on tomatoes, eggplant, and bell pepper respectively. The highest monthly average numbers in June on tomatoes recorded 26.25±3.86, in May on eggplants recorded 20.25±6.50, and in June on bell pepper recorded (20.25±6.50 individuals/ 50 infested leaflets). Moreover the highest average monthly percentages of parasitism occurred in May recorded (45.71±27.66, 41.04±25.13 and 25.19±11.19) on tomatoes, eggplants and bell pepper respectively.

Keywords: Diglyphus isaea; abundance; host plants.

1. INTRODUCTION

The agromyzid leafminers, *Liriomyza spp* cause direct and indirect damage to a wide variety of vegetable crops and ornamentals [1]. *Diglyphus* spp. wasps are promising biological control agents for agromyzid leafminers (Diptera: Agromyzidae) The most dominant species in North America and the Mediterranean area are *Diglyphus isaea* (Walker), *D. begini* (Ashmead), *D. websteri* (Crawford), *D. intermedius* (Girault), *D. pulchripes* (Crawford) and *D. carlylei* [2]. *Diglyphus* spp. Are the most important leafminer larval parasitoids. *Diglyphus begini* (Ashmead), *D. intermedius* (Girault) and *D. isaea* (Walker) were found to be the most effective antagonists against the leafminer larvae on cultivated and spontaneous plants [3]. *D isaea* is a commercially reared parasitoid of agromyzid leafminers. This wasp is marketed for control of Liriomyza species on vegetables [4]. *L. bryonia* is a widspread polyphagous leafminer species that attacks economic important host plants 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*) [5]. In the pan-temperate region, *L. bryoniae* has been reported to complete its life cycle on plants from 16 families [6]. *Diglyphus isaea* is a primary parasitoid of agromyzid leaf miners and has been commercialized as biological control agent [7]. This species is a primary ectoparasitoid capable of developing on at least 18 different agromyzid species [8]. Minkenberg & van Lenteren, [9] describe *D. isaea* as an associated parasitoid with *Liriomyza* in herbaceous plants but scarce in trees. *D isaea* has certainly been used as a biological control antagonist in a wide range of host plants, populations of *D. isaea* have been found to be abundant on nearly 14 species of weedy plant in northern Italy [10]. *Diglyphus isaea* has been released as a biological control antagonist against *L. bryonia* since the mid-1980s [11]. *D. isaea* was the most dominant and effective ectoparasitoid species against *L. trifolii* of the parasitoid complex which recorded on the serpentine leafminer *L. trifolii* which contained also *Opius pallipes* Wesmeal and *Chrysocharis parksi* Crawford (Hymenoptera: Eulophidae) as an endoparasitoids [12]. Ozawa et al. [13] found that the most 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 [14] reported that through a survey started in 1993 in several protected crops, two ectoparastiods of *Liriomyza* spp, *D. isaea* and *D. poppoe* have been found to be dominant at seasonal intervals, reaching rate of parasitism of 80-85% with predominance of *D. isaea*. Among the parasitoid complex of *Liriomyza* spp. in the Iranian fauna which contained several parasitoid species, the Eulophid *D.isaea* was the most common parasitoid [15]. From the available literature, few authors have studied the role of the parasitoid *D. isaea* as biocontrol agent against the tomato leafminer *L. bryonia* Therefore the present investigation was undertaken to study the role of the parasitoid *D. isaea* on *L. bryonia* on some summer economic host plants under the Libyan conditions.

2. MATERIALS AND METHODS

The present study targeted the plant canopy in Ojilat region during the growing season summer/ fall from may to august 2016. Three summer host plants were targeted for this study which were [tomatoes (*Solanum lycopersicum*), Bell peppers (*Capsicum annuum*), egg plants (*Solanum melongena*)]. The experimental field was about 1000 m^2 devided to three sections [nearly 330m^2 for each host plant]. fifty leaves infested with *L. bryoina* were taken from each host. Samples were kept in plastic bags and transferred to be examined in the laboratory a stereo binuclear microscope of magnification of 48 X was used. Number of living *L. bryoina* larvae, immature stages of the ectoparasitoid *D. isaea* were counted and recorded. Normal

agricultural measurements of fertilizing and irrigation were followed and no insecticide applications took place. Sampling started one weak after nurslings were replanted and continued at weekly intervals until the end of the successive season.

3. RESULTS AND DISCUSSION

Fig. 1 presents the numbers of the ectoparasitoid *D. isaea* and the percentage of parasitism on three summer host plants.

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

On eggplants the population of *D. isaea* showed 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 pepper, the population abundance of *D. isaea* reached three peaks (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% during the growing season.

It could be concluded that, the percentage of natural parasitism by *D. isaea* reached more than 38% in all studied host plants , so it seems to be a very promised natural antagonist on the tomato leaf miner *L. bryonia* . Elkhouly [16] 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. [17] and Khouly, [12] revealed that *D. isaea* had high rates of parasitism on *L.trifolii* in open fields .they indicated that the parasitoid preferred cow pea and tomatoes than kidney bean as a summer host plant, they proposed that the larval ectopoarasitoid, *D. isaea* prefers the high populations of its insect host.

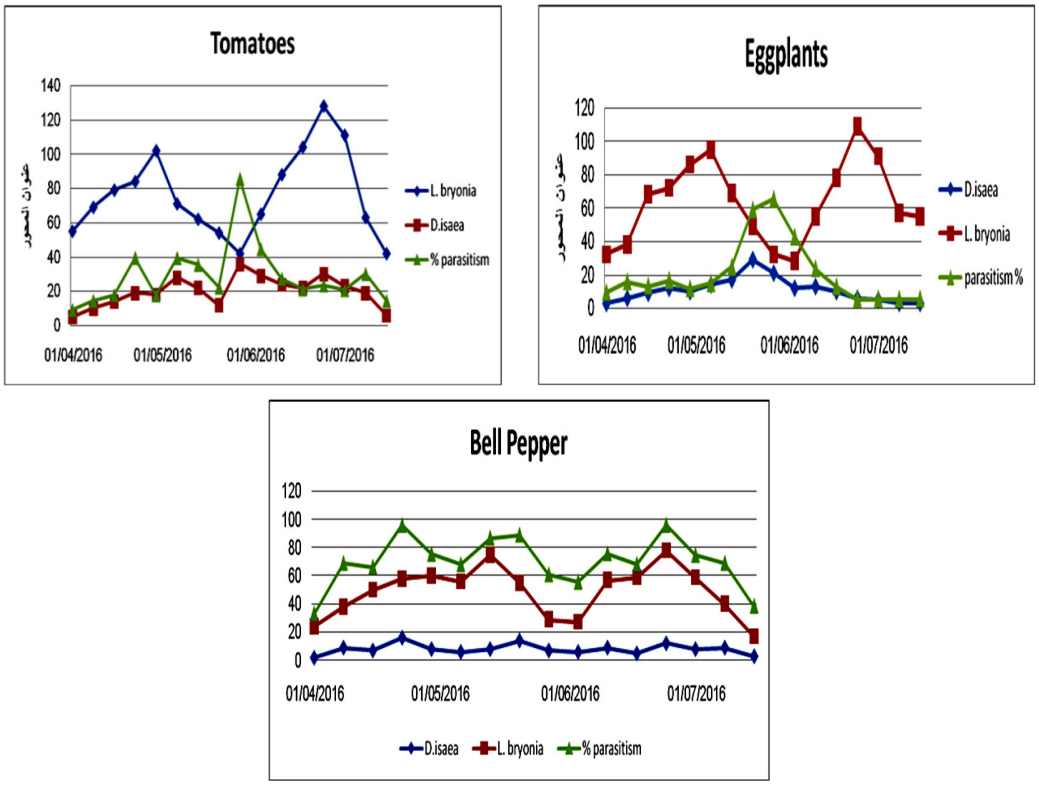

Fig. 1. Population abundance of the ectoparasitoid D.isaea and percentage of parasitism on three summer host plants in Ojilate region during the growing season 2016

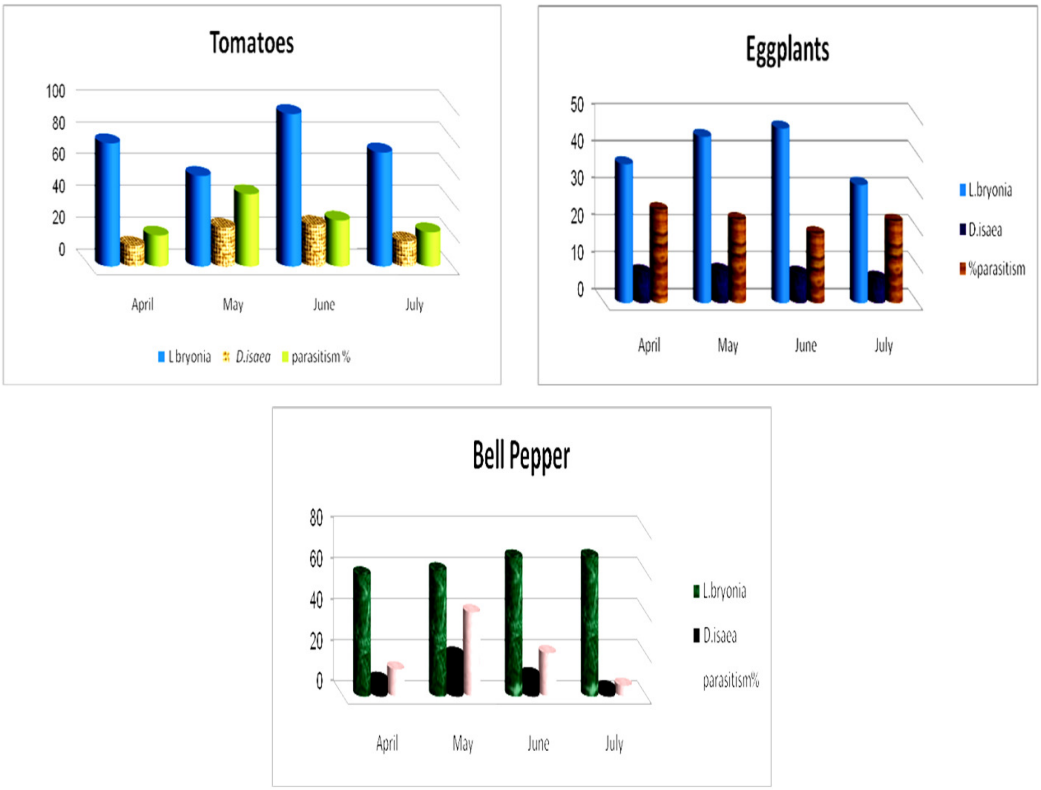

Fig. 2. Monthly average numbers of the tomato leafminer *L. bryonia* and the larval ectoparasitpid *D. isaea* on three summer host plants

As shown in Fig. 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). While, the monthly average percentages of parasitism reached its highest numbers in May recording (45.71 ± 27.66, 41.04 ± 25.13) on tomatoes and eggplants and 25.19 ± 11.19 on bell pepper.

Theses results show that that the larval ectopoarasitoid, *D. isaea* reached its highest average numbers in June and May when its host *L. bryonia* occurs at high populations because *D. isaea* seems to prefers the high populations of its insect host [18]. Data presented by EL Khouly, [19] showed that *D. isaea* females killed 21.3±4.7% of *L. trifolii* larvae 9.6±3.7% of them were host fed and 12.3±3.6% larvae were oviposited. So these results are in agreement with his finding. Another possible explanations were presented by Patel *et al*. [20] who found that the parasitoid *Diglyphus intermedius* kills more hosts than it parasitize . In earlier study, Heinz and Parrella [21] observed that *Diglyphus begini* killed 1.3 *L. trifolii* larvae fore every larva used for oviposition. Eventually, despite host – feeding is an effective killing behavior against Agromized larvae which supporting in combination with oviposition the efficiency of *D. isaea* females, it resulting no reproductive output of the parasitoid progeny.

4. CONCLUSION

In comparison with the former studies containing our previous results, the parasitoid *D. isaea* showed relatively low abundance on the present host plants and the presents insect host a possible proposal is that *D. isaea* may be *L. trifolii* than *L. bryonia* as an insect host. The climatic conditions and the poor plant canopy in Libya compared with those in Egypt may be an effective reasons of the poor abundance of *D. isaea.*

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Murphy ST, LaSalle J. Balancing biological control strategies in the IPM of New World Invasive *Liriomyza* leafminers in field vegetable crops. Biocontrol News Info. 1999;20(3):91-104.
2. Stegmaier CE. Parasitic hymenoptera bred from the family *Agromyzidae* (Diptera) with special reference to south Florida. Florida Entomologist. 1972;55:273-282.
3. Linden A. Biological control of leafminers on vegetable crops. In: Biocontrol in Protected Culture. Ed.by Heinz KM, van Driesche RG, Parrella M. P. Batavia, IL: Ball Publishing. 2004;239–251.
4. Carvalho AR, Bueno VHP, Silvara Db, Costa VA. Record of *Diglyphus* walker (Hymenoptera: Eulophidae) species in Brazil. Neotropical Entomology; 2017. ISSN: 1519-566X
5. Abul-Nasr S, Assem AH. A leaf miner, *Liriomyza bryoniae* Kalt), attacking cucurbitaceous plants in Egypt. Bulletin of the Entomological Society of Egypt. 1961;45:401-403.
6. Spencer KA.). *Agromyzidae* (Diptera) of economic importance. Series. Entomol. Junk. The Hague. 1973;9:1-4.
7. Sha ZL, Zhu CD, Murphy RW, Huang DW. *Dighyphus 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. 2007;45(2):128-135.
8. Boucek Z, Askew RR. Hym. Chalcidoidea. palearctic. Eulophidae (excl. Tetrastichinae). Le Francois, Paris. 1968;254.
9. Minkenberg OPJM, Van- Lenteren JC. Evaluation of parasitic wasps for biological control of leaf miners, *Liriomyza sp*., in greenhouses. Bull. OILB/ SROP. 1987;10:115–120.
10. Burgio G, Lanzoni A, Navone P, Van Achterberg K, Masetti A. Parasitic hymenoptera fauna on *Agromyzidae* (Diptera) colonizing weeds in ecological compensation areas in northern Italian agroecosystems. Journal of Economic Entomology. 2007;100(2):298-306.
11. Malais MH, Ravensberg WJ. Knowing and recognizing the biology of glasshouse pests and their Natural enemies (2nd ed.). The Netherlands: Koppert B.V. Reed Bussiness Information; 2003.
12. El.Khouly AR. Studies on some natural enemies associated with the serpentine leaf miner *Liriomyza trifolii* (Burgess). M. Sc. Thesis, Fac., Agric., Mansoura Univ. 2003;116.
13. Ozawa A, Saito T, Ota M. Biological control of the American serpentine leafminer, Liriomyza trifolii (Burgess), on tomato in greenhouses by parasitoids. II. Evaluation of biological control by *Diglyphus isaea* (Walker) and Dacnusa siberica Telenga incommercial greenhouses. JPN J A ENT. 2001;45(2): 61-74.
14. Goncalves MA, Almeida L. Biology of two parasitoids of leaf miners *Liriomyza* spp, *Diglyphus isaea* and *D. poppoea* in southern Portugal. J. Food .Agric. Environ. 2005;3(2):154-156.
15. Asadi R, Talebi AA, Fathipour Y, Moharramipour S, Rakhshani E. Identifcation of parasitoids and seasonal parasitism of Agromyzid leaf miners genus *Liriomyza* (Dip: Agromyzidae) in Varamin. Iran. J. Agric. Sci. and Tech. 2006;8(4): 293-303.
16. El.Khouly AR. Efficiency of some hymenopterous parasitoids on serpentine leaf miner *Liriomyza trifolii* (Burgess). PhD. Thesis, Fac., Agric., Mansoura univ. 2009;185.
17. Awadalla SS, Shanab LM, Abd El-Kareim AI, El-Nagar MS, El-Khouly ER. Host plant preference of the ectoparasitoid *Diglyphus isaea* Walker (Hymenoptera: Eulophidae). J. Agric. Mansoura Univ. 2009;34(1):505-510.
18. Linden A. Biological control of leaf miners in glasshouse lettuce. "*Liriomyza*". Conference on leaf mining flies in cultivated plants. Montpellier- France. 1993.
19. Awadalla SS, Shanab LM, Abd El-Kareim AI, El-Nagar MS, El-Khouly ER. Host plant preference of the ectoparasitoid Diglyphus isaea Walker (Hymenoptera: Eulophidae). J. Agric. Mansoura Univ. 2009;34(1):505-510.
20. Patel KJ, Schuster DJ, Smerage GH. Density dependant parasitism and host-killing of *Liriomyza trifolii* (Diptera: Agromyzidae) by *Diglyphus intermedius* (Hymenoptera: Eulophidae) Fla. Entomol. 2005;86:8-14.

21. Heinz KM, Parrella MP. Holarctic distribution of the leaf miner parasitoid *Diglyphus begini* (Hymenoptera: Eulophidae) and notes of its life history attacking *Liriomyza trifolii* (Diptera: Agromyzidae) in Chrysanthemum. Ann. Entomol. Soc. America. 1990;83(5):916-924.

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