Field Studies on Supper Parasitism of the Larval Pupal Endoparasitiod *Opius pallipes* on the Tomato Leaf Miner *Liriomyza bryoniae* and the Serpentine Leaf Miner *Liriomyza trifolii* in Libya

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Short Research Article

ABSTRACT

Objectives: The present study aimed to investigate Super parasitism behavior of the larval pupal endoparasitoid *O. pallipes* in the field on two leaf mining insect hosts *L. trifolii* and *L. bryoniae* in Alojelat region during the winter growing season 2016/2017 using Broad bean (*Vecia faba*), as a host plant.

Methods: Broad bean (*Vecia faba*), was targeted as a host plant because it has a heavy infestation by the two leaf mining insects combined with a good population of *O. pallipes*. 100 parasitized larvae were collected. Larvae were checked and the number of the parasitoid immature stages were counted. Solitary parasitized and supper parasitized larvae were counted for the two insect hosts.

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Results: Super parasitism caused by *O. pallipes* females on *L. trifolii* recorded high numbers during December and April and reached its peak on December 31th recording (36 superparasitized larvae/100 parasitized ones), while the host population recorded (136 *L. trifolii* larvae/100 leaflets) at the same time. Super parasitism decreased to its lowest number on March 4th recording (6 super parasitized larvae/100 parasitized ones) where the host population recorded (251 larvae/ 100 leaflets) at the same time. While, super parasitism caused by *O. pallipes* females on *L. bryoniae* recorded high numbers during December and April and reached its peak at December 17th recording (27 super parasitized larvae/100 parasitized ones), while the host population was (73 larvae/100 leaflets), The lowest number of super parasitism was observed on March 11th (4.0 super parasitized larvae/100 parasitized ones) when the host population was (142 larvae/100 leaflets) at the same time.

Conclusion: *O. pallipes* females reached its highest numbers at the low population levels of the insect host on either *L. trifolii* or *L. bryoniae* with low preference towards *L. trifolii* so, super parasitism by *O. pallipes* recorded slightly high numbers on *L. trifolii* larvae compared with *L. bryoniae.*

Keywords: Super parasitism; O. pallipes; L. trifolii; L. bryoniae; Libya.

1. INTRODUCTION

Braconidae (Hymenoptera) is one of the most fascinating, diverse, and beneficial groups of insects. Braconids are valued for their ability to kill different pest insects, especially forest pests and insects that cause economic damage to some important vegetable and ornamental crops. However, they are underused as biocontrol agents, as many species are understudied or simply unknown to science. Currently, there are more than 19,000 described species [1], making *Braconidae* the second largest family in Hymenoptera next to its sister lineage, *Ichneumonidae*. Approximately 20,000 species have been described since 2005. However, the known species likely represent only 30–50% of the actual number of species on Earth [2]. Members of *Braconidae* have a wide range of parasitic lifestyles and a few rare species are herbivorous [3]. Generally, parasitic Braconids are either ectoparasitic, feeding on the outside of their host, or endoparasitic, feeding from within their host. Braconids may cause permanent paralysis of the host upon oviposition, and thus the host can no longer continue development (Idiobiosis) [4–6]. Alternatively, some parasitoids allow their hosts to continue development throughout much of the parasitoid's life (Koinobiosis) [4]. Many Braconids can be solitary, with one individual using one host. However, others are gregarious, as multiple parasitoids from the same mother utilize the same host [7]. Polyembryony (more than one embryo from a single egg) also occurs among some Braconids, although it is relatively rare [8]. Opiinae is a large subfamily containing over 1863 described species in 33 genera worldwide [9]. Opiinae often parasitise a late larval instar, but species are known to infest eggs and early instar larvae. The most favored host families are Agromyzidae, Anthomyiidae, Tephritidae, and Ephydridae [10]. *O.pallipes* which live as endoparasitoid of the dipteran larvae and pupate within the puparium of the host was recorded on some Agromyzid leafminers such as *L.trifolii* , *L. bryoniae* and *L. strigata* [11]. Hendrikse [12] studied the searching behavior of *O.pallipes* and reported, the female hovers around the leaves. After landing on the leaf, she scans the leaf surface by antennae and deposit eggs by ovipositor when the host larva is found. She may reject or lay eggs on it. Older larvae are found faster than younger ones. Host feeding (killing host with no oviposition) is never observed . *O.pallipes* females can detect plants infested with leafminers and can discriminate between parasitized and unparasitized hosts. El.Khouly [13] concluded that the female of the larval – pupal endoparasitoid *O.pallipes* could successfully deposit eggs in the 2nd or 3rd of *L.trifolii* instar larvae. The parasitoid eggs or larvae could successfully complete their development in the host larvae and even after pupation. So, host size was not an important factor in parasitism. El.Khouly [14] studied the influence of the female feeding diet on some biological aspects of the *O.pallipes* and found that, the number of deposited eggs, number of parasitized larvae and, number of super parasitized larvae per female were insignificantly high when the females were fed on 10% sugar solution recording 9.1±4.5 eggs/ female, 6.7±2.8 parasitized larvae/ female and 1.7±1.8 super parasitized larvae / female, respectively with insignificant differences. He also concluded that, oviposition, postoviposition periods and female longevity were significantly affected with different diet treatments.

El.Khouly [14] concluded that, superparasitism caused by *O. pallipes* females on *L.trifolii* larvae reached its highest numbers on the low population levels of the host; and the reveres is true.

From the available literature very few authors have studied the biological behavior of *O. pallipes* [13-17]. Therefore, the present investigation was undertaken to study superparasitism behavior of the larval pupal endoparasitoid *O. pallipes* on two leaf mining insect hosts *L. trifolii* and *L. bryoniae*.

2. MATERIALS AND METHODS

2.1 Seasonal Abundance of the Tomato Leaf Miner *L. bryoniae* and the Serpentine Leaf Miner *L. trifolii*

Broad bean (*Vecia faba*), was targeted as a host plant because it has a heavy infestation by the two leaf mining insects combined with a good population of *O. pallipes*. Hundred infested leaves with *L. bryonia*e and another Hundred infested ones with *L. trifolii* were taken. Some leaves had the two types of infestation, only the targeted leafmining species (*L. bryonia*e or *L. trifolii*) were counted in each group. Samples were kept in plastic bags and transferred to be examined in the laboratory. Number of *L. bryonia*e and *L. trifolii* larvae were counted and recorded.

2.2 Superparasitism of the Parasitoid *O. pallipes*

To evaluate superparasitism for the parasitoids *O. pallipes*, 100 parasitized larvae were collected. Larvae were checked and the number of the parasitoid immature stages was counted according to Linden and Achterberg [16]. The leafminer larvae were dissected under the microscope. Each leaf miner larva was removed from the leaf and put in a droplet of water. At a magnification of 48x, the larvae were opened with a pair of minute tweezers. The contents of the larvae and the parasitoid immature stages spread in the droplet of water. The parasitoid eggs or larvae could be counted and recorded. Normal agricultural practices of fertilizing and irrigation were followed and no chemical control measurements were applied. Samples were taken from the appearance of the emergence of the first leaves and continued weekly until harvest.

3. RESULTS

3.1 Superparasitism on *L. trifolii*

As shown in Fig. 1, superparasitism caused by *O. pallipes* females recorded high numbers during December and April and reached its peak on December 31th recording (36 superparasitized larvae/100 parasitized ones), while the host population recorded (136 *L. trifolii* larvae/100 leaflets) at the same time. Superparasitism decreased to its lowest number on March 4th recording (6 superparasitized larvae/100 parasitized ones) where the host population was (251 larvae/ 100 leaflets) at the same time.

3.2 Superparasitism on *L. bryoniae*

As shown in Fig. 2, superparasitism caused by *O. pallipes* females recorded high numbers during December and April and reached its peak on December 17th recording (27 superparasitized larvae/100 parasitized ones), while the host population was (73 larvae/100 leaflets), The lowest number of superparasitism was observed on March 11th (4.0 superparasitized larvae/100 parasitized ones) when the host population was (142 larvae/100 leaflets) at the same time.

4. DISCUSSION

The larval pupal endoparasitoid *O. pallipes* prefers the low densities of its host which occurred in the first and last month of the growing season, so *O. pallipes* females didn't find enough host larvae to distribute their reproductive output in solitary parasitism, by the time when *L. trifolii* is highly abundant super parasitism occurs at very low numbers. The same behavior also occurring on *L .bryoniae* but because *O. pallipes* showed low preference towards *L.bryoniae* compared with *L. trifolii*, so the relatively low populations of *O. pallipes* on *L.bryoniae* combined with low numbers of superarasitised larvae (Fig. 3). Superparasitized larvae/female recorded by El-Khouly [14] were 2.1 and 1.7 on the second and third instars of *L. trifolii* larvae with no significant differences in laboratory study.

In a laboratory study *O. pallipes* females showed higher preference towards *L. trifolii* larvae than *L. bryoniae* in a choice test and less preference towards *L. trifolii* in no choice test. A possible explanation is that in no choice test either *L. trifolii* or *L. bryonia*e larvae were the only available host so *O. pallipes* females had to deposit eggs and feed on the available insect host, while in the choice test the parasitoid females had the chance to choose their preferred host [14]. The preference of *L. trifolii* may be due to mining behavior of its larvae that mines the upper palisade Mesophyll of the leaves, while *L. bryonia*e larvae mines the spongy Mesophyll [18]. Moreover the nutrition contents of *L. trifolii* larvae may be more preferred to *O. pallipes* females than *L. bryonia*e. [15] Linden used *O. pallipes* which thought to be the promising endoparasitoid against *L. bryonia*e in Dutch greenhouses but *O. pallipes* failed to control *L. bryonia*e. Dissection of the leaf miner larvae showed that *O. pallipes* females could successfully put the eggs but the eggs were encapsulated and failed to be developed. This may explain the low preference of *O. pallipes* females towards *L. bryonia*e larvae. We cannot also role out the very enormous competition of the larval ectoparasitoid *Diglyphus isaea* that needs high densities of its insect host with a very high killing capacity of its females that kill more leafminer larvae for feeding than those for oviposition, in both cases host larvae are not suitable as a host for *O. pallipes*.

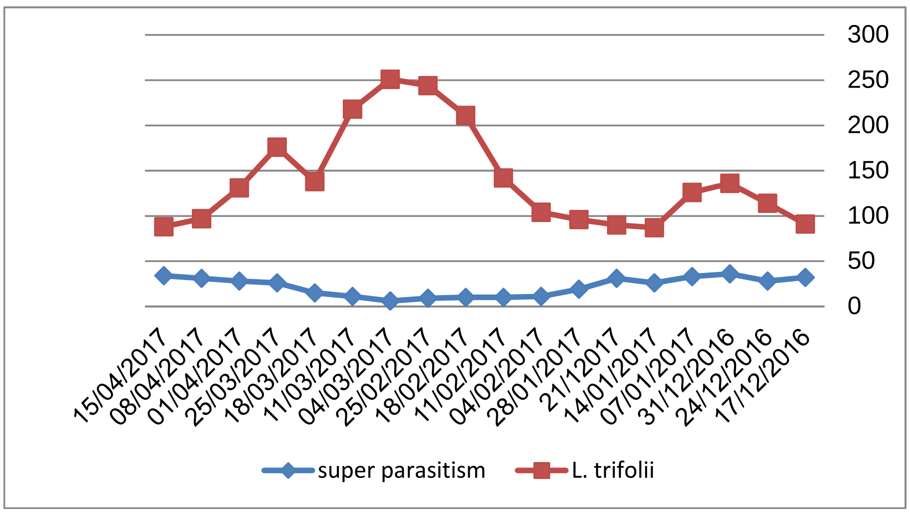

Fig. 1. Superparasitism of *O. pallipes* (superparasitized larvae/100 parasitized ones) as affected by the numbers of *L. trifolii*

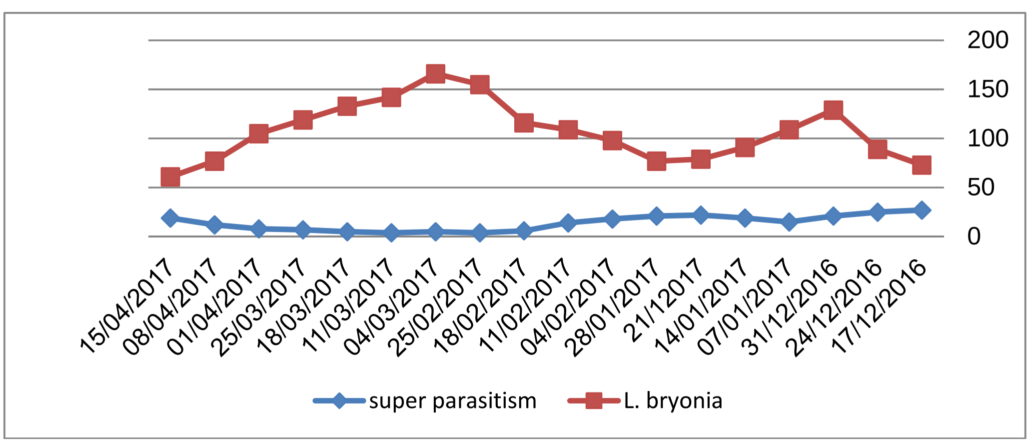

Fig. 2. Superparasitism of *O. pallipes* (superparasitized larvae/100 parasitized ones) as affected by the numbers of *L.bryoniae*

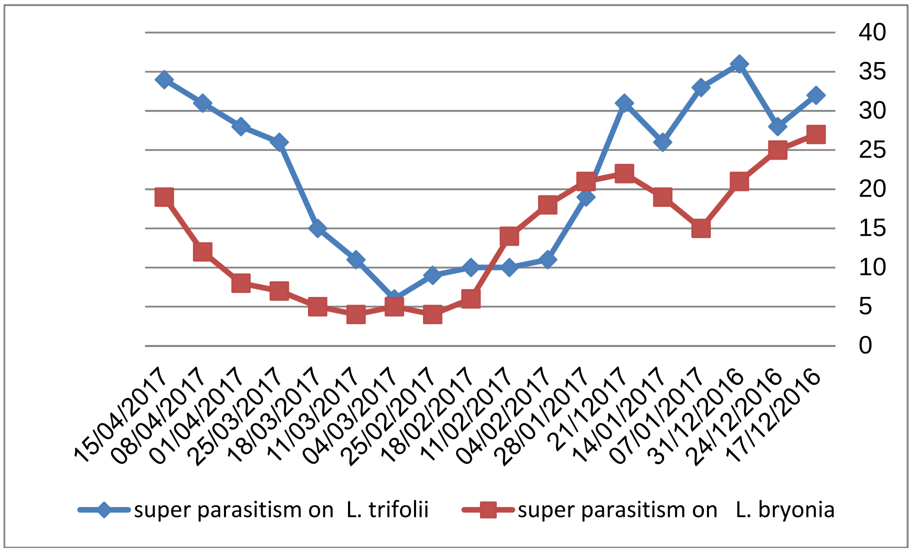

Fig. 3. Number of super parasitized larvae of *Lbryoniae* and *L. trifolii* by *O. pallipes*

5. CONCLUSION

It could be concluded that superparasitism caused by *O. pallipes* females reached its highest numbers at the low population levels of the insect host on either *L. trifolii* or *L. bryoniae* with low preference towards *L. trifolii.* In fact further studies on this behavior should be undertaken because *O. pallipes* is describing as a solitary parasitoid and very few studies are available while, the description of the biology of this parasitoid needs more efforts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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