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Evaluation of The Predatory Efficiency of Orius Albidipennis Reuter for Two Prey Species Myzus Persicae (Sulzer) and Thrips Tabaci Lind. on The Carrot Plant in Laboratory

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Abstract. The study aimed to investigate the effect of different densities of M.persicae and T. tabaci on the predatory ability of the predator O. albidipennis and determine the preference for one of the two prey, in addition to assessing the in vitro predator's efficiency in reducing the number of aphids on the carrot plant. The results indicated that the rates of predated adult and nymph thrips were significantly higher than that of predated aphids. The highest rate of predation for nymphs and adults thrips was 33.2 and 25 preys per day, respectively, at a density of 60prey/container, while the highest rate of predation of adults and nymphs of aphids was 19 and 13.2prey/day, respectively, at a density of 60prey/container. The food preference experiment showed that the adults of the predator O. albidipennis feed on the immature stages thrips and aphids when introduced together and have no clear preference for one of the prey. The results of evaluating the efficiency of predator adults on reducing different densities of aphids showed that the predator was effectively able to reduce the population increase of aphids when the insect densities were 10, 20 or 30 insect. however, the predator was not effective when introduced to aphids at starting density of 40, no significant difference was found due to predator presence or absence as the aphids population density were 118.4 and 135.2 insects/cage after four days, respectively.

Keywords. Biological control, Thrips tabaci, Myzus persicae, Orius albidipennis.

I. INTRODUCTION

The green peach aphid *Myzus persicae* Sulzer (Homoptera: Aphididae) is an important pest on vegetable and fruit crops in different regions of the world, infects more than 400 species of plants [1,2]. *Thrips tabaci* Lind (Thripidae: Thysanoptera) is a widespread pest of a large number of field and greenhouse crops, affecting more than 100 plant species [3,4]. Onion thrips and green plum aphids cause direct damage to crops through feeding on plants and indirectly as a vector for destructive plant viruses. It is difficult to control these pests with insecticides due to their small size and hidden habits [5], and their development of insecticide-resistant groups [6,7]. As a result, it is of necessity finding safe and effective alternative methods to control these pests.

The predatory bug is the genus *Orius* spp. Among the most successful control agents against common pests such as thrips, whitefly, mites and aphids [8-12]. The success of this predator is due to a set of behavioral and environmental characteristics, including the predator's ability to be present on crops when pests are absent or at low densities, and its ability to supplement its diet with alternative plant sources that enable it to survive periods of absence of prey[11-14]. The other reason is that it is a versatile diet and thus is highly effective in controlling several types of pests [10,15]. The predator's high reproduction rate, its relatively easy production in large quantities, its ability to respond to different environments, the fact that all its stages are predators and its high potential to prey on more than its need, make it successful in a rapid response to increasing the number of pests.

Several species of *Orius* spp. are considered to be effective biological agents in controlling several types of thrips, including *T. tabaci* [16-19]. Other species of the genus *Orius* also play an important role in biological control of a large number of aphid species, for example *M. persicae* have been recorded as suitable prey for several species of *Orius* spp. [20,21].

The species *Orius albidipennis* is the most common species of the *Orius* genus in the Mediterranean countries. Several studies have been conducted on its behavior, biological properties, and predatory competence [20,22]. Due to

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the importance of these pests and the lack of studies on the ability of the predator *O. albidipennis* to control these pests, this study aimed to evaluate predator predation rates for different population densities of *M. persicae* and *T. tabaci*, and determine whether there is a preference for one of the two prey, in addition to evaluating the predator's efficiency in Reducing the population of aphids on carrot plant under laboratory conditions. The current study may also demonstrate the effectiveness of *O. albidipennis* in controlling different types of pests such as thrips and aphids.

II. MATERIALS AND METHODS

- **Insect colonies preparation**

The experiment was carried out in the postgraduate laboratory at the College of Agriculture - University of Basra. In order to obtain pure insect colonies at different stages of green peach aphids and onion thrips for the laboratory experiments, the insects were bred in the growth rooms, under a temperature of 25 ± 2C, relative humidity of 65 ± 5%, and a period of16 hours light and 8 hours of dark using white LED light with an intensity of 2000 lux, [11,23].

- **Colony of green plums Myzus persicae (sulzer)**

Leaves infected with different stages of the green peach insect *M. persicae* were brought from Al-Houta area in Shatt Al-Arab district. The samples were examined to confirm being free of biological enemies or alien species. the aphid insects were diagnosed with the aid of Dr. Khaled Jaber Abdul Razzaq in the Laboratory of Insect Classification / Faculty of Agriculture / Al-Muthanna University. The infected leaves were placed inside a 30 cm3 wooden cage with a wooden base and covered on all sides with a transparent cloth. Plastic pots planted with radish plants, the preferred host for this insect, were placed inside the cage and the leaves were removed after asuring that aphids were transferred to the radish plants. The colony's reproduction was maintained by adding new radish pots as required and left to multiply for 2-3 generations before being used in subsequent laboratory experiments.

- **Onion thrips Thrips tabaci colony**

The onion thrips colony was established from insects that were collected by the Aspirator from the onion and garlic plants grown in the Agricultural Research Station of the College of Agriculture. Thrips were diagnosed with the help of Dr. Awatef Abdel Fattah Hammoudi in the Insect Laboratory, College of Agriculture / University of Baghdad. The insects were kept for reproduction in wooden cages, previously mentioned, containing plastic pots planted with cucumber and onion plants. the plants pots were replaced weekly and the colony was left for reproduction for 2-3 generations before using in experiments.

- **The predator O. albidipennis**

The adult predator insects were collected by insect collecting net from a field planted with carrot *Daucus carota* in Al Madina district north of Basra. The insects were placed in transparent plastic containers (18 x 12 x 8 cm). A square hole of 10 x 10 cm was made in the container lid and covered with a transparent cloth for ventilation. The predator adults were provided with adequate numbers of prey and a piece of cotton soaked in 50% sucrose solution. The containers were transferred to the insect laboratory and stored in the growth chamber intil using the predator in subsequent experiments. The predator was diagnosed by Prof. Dr. Iyad Abdul-Wahab Abdul-Qadir, the specialist in insect classification, and one teaching staff of the College of Agriculture / University of Basra.

- **Laboratory experiments**

All experiments were performed in the same growth chambers and under the same conditions as previously mentioned.

- **Predation efficacy of O. albidipennis adults on different densities of nymphs and adults on onion thrips T. tabaci**

Transparent plastic containers (6 x 6 x 4) cm were used containing a 1 cm thickness layer of 2% water agar. A piece of carrot leaf of 5 cm was placed and the stalk was wrapped with a cotton swab moistened with a sugar solution to maintain the leaf moisture and keep it soft as it was food For prey and a source of moisture for the predator. The container lid was punched several holes and covered with a piece of transparent cloth for ventilation.

A fine brush and an aspirator were used to transfer different numbers of adults and 2nd instar nymphs *T. tabaci* to be (10, 20, 40, 60) insects/container from the insect rearing colony. The insects were left two hours to settle, and then one adult predator, starved for 24 hours to stimulate predation, was introduced to each container. After 24 hours, the predator was removed and the number of consumed preys and the remaining live prey was counted using OPTIKA compound microscope under 10x magnification. Each treatment was repeated 5 times while checking the natural mortality rate of the prey in the absence of the predator in 5 containers containing the same densities of prey [12,22].

- **Predation efficacy of O. albidipennis adults on different densities of nymphs and adults of green peach aphid M. persicae**

The same procedure were followed in the previous experiment (onion thrips) except that the nymphs were between the second and third instar.

- **Feed preference for O. albidipennis**

To determine if the predator *O. albidipennis* has a higher preference for one of the two prey. 30 2nd instar nymphs of *T. tabaci* or 30 2nd-3rd instar nymphs of green peach *M. persicae* were placed separately or combined (30 of each insect togather) in each container. The insects were left to settle, and a full-starved predator adult insect was placed in each container. After 24 hours, the predator was removed and number of prey remaining on the leaves was calculated using a dissecting microscope to determine the number of prey consumed. Each treatment was repeated 5 times. The experiment was conducted according to the method [15].

- **Evaluation of O. albidipennis ability to control and reduce M. persicae population**

Different numbers of adult *M. persicae* (40,30,20,10) insect / plant were distributed as homogeneously as possible on carrot plants in the stage of five real leaves using micro-brushes. Carrot plants were planted in plastic pots, one plant/pot, 11 cm diameter and 11 cm height. The aphids adults were kept using polyethylene cages covering the potted plants. The cage consists of a piece of transparent plastic paper 20 x 30 cm folded and fastened at both ends by silicone to form a cylinder 20 cm high and 10 cm diameter, the upper part of the cage was covered with a transparent cloth that was fixed with silicone. One adult predator insect was introduced to each cage. 2 cm of sand was placed around the base of the cage to ensure the predator or prey was prevented from escaping. Each treatment was 5 replications in addition to 5 replicates of control for each treatment without the predator. Number of aphids was calculated after 4 days [24,25].

- **Data analysis**

The laboratory experiments were according to complete randomized design CRD. The results were analyzed using GenStat version 2012 and the averages were compared according to least significant difference L.S.D. [26].

III. RESULTS AND DISCUSSION

- **Prédation efficace of O. albidipennis adults on different densities of nymphs and adults on onion thrips T. tabaci**

Figure (1) shows that there is a direct relationship between predation efficiency and the increase in the number of onion thrips nymphs given to the predator. The predation efficiency increased with the increase in the number of prey, and the highest rate of predation reached 33.2 prey / day at a density of 60 prey / container, which did not differ significantly from the treatment of 40 prey / container density of 30.6 prey / day. The highest predator efficiency of onion thrips adults reached 25 prey / day at a density of 60 prey / container and did not differ from the treatment of 40 prey / container density of 23.2prey/day.

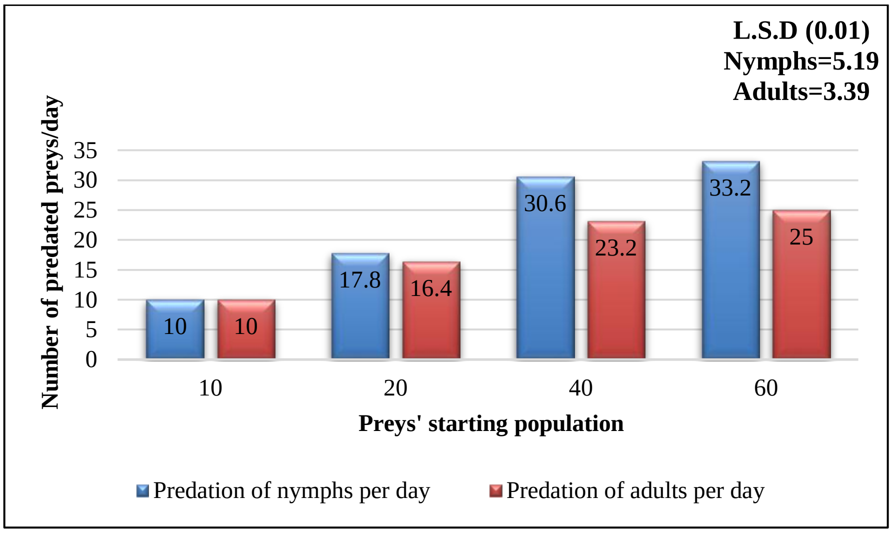

FIGURE 1. Predation of predator *O. albidipennis* adults on nymphs and adults of the onion thrips insects.

The reason for the higher predator's predator efficiency when increasing the prey density may be attributed to the decrease in the search period that the predator needs to find the prey. That is, *O. albidipennis* needs less time to search for prey when there are higher prey densities. The ability of the predator to prey on more nymphs compared to adults is generally due to the ability of adults to move and escape compared to nymphs.

Fathi *et al*. [16] found that one adult *O. niger* preyed 9.4, 16.63 and 16.89 prey from onion thrips at prey densities of 10, 50 and 60 prey / plate, respectively. Chow *et al*. [27] stated that the predator *O. insidiosus* is more efficient at preying on the adult mite, *Amblyseius degenerans*, while it is less efficient in the predation of adult thrips, *Frankliniella occidentalis*. This is generally due to the difference in size and mobility between the two prey. *O. insidiosus* are effective predators of nymphs and adults of thrips from *Frankliniella* spp. Often the nymphs are preyed first, then the adult insects because the adults are more able to move and escape from predation [28]. Bonte *et al*. [21] reported that the adults of the predator *O. thripoborus* and *O. naivashae* preyed on 23.94 and 17.64 of the nymphs of *F. occidentalis* at the density of 40 nymphs/plate, respectively, and 7.87 and 4.33 of the thrips adults of the same species at densities of 20 adult/plate after 24 hours, respectively. Tommasini *et al*. [29] recorded that predation rates on thrips, *F. occidentalis*, by predator *Orius* spp. adults were between 10.2 and 14.9 insects per day. Liu *et al*. [23] found that predator *O. sauteri* daily consumes approximately 9.4 of *Megalurothrips usitatus* when the prey density is 10 insects/plate. The highest predation rate for thrips was 45.3 per adult female of predator when 120 prey were provided per plate within 24 hours. Hamed [22] found that the predator *O. albidipennis* preys on an average of 10 nymphs and adults of *T. tabaci* when there are only 10 insects/plate per predator per day, and the highest rate of predation was 44.00 and 38.67 nymphs and adults thrips respectively for each adult predator when 60 prey are available per dish in 24 hours. Butler and O'Neil [8] indicated that the number of prey attacked by adults of predator *O. insidiosus* is relatively constant as the predator ages. The maximum predator prey efficiency was 11.6 insects from soybean thrips, *Neohydatothrips variabilis*, within 24 hours, at prey density of 20. Kohno and Kashio [30] indicated that individuals of either sex of *Orius* spp., preyed on more than 100 nymphs of Thrips *F. occidentalis* during the nymphal stage only.

- **Prédation efficace of O. albidipennis adults on different densities of nymphs and adults of green peach aphid M. persicae**

The results of Figure (2) showed that the maximum number of nymphs that preyed was 19 prey / day at a density of 60 prey / container, which did not differ significantly from the treatment of 40 prey / container density of 17.4 prey / day. The predator adults recorded the highest predatory efficiency on the adults of the green peach aphid insect 13.2 prey / day at a density of 60 prey / container, which did not differ significantly from the treatment of 40 prey / container density of 12.6 prey / day. Rutledge and O'Neil [25] reported that the highest predatory efficacy of *O. insidiosus* was 19.25 adult soybean aphid *Aphis glycines* at a density of 64 insects/plate within 24 hours. While Rutledge *et al.* [24] indicated that the predator *O. insidiosus* consumed 10.23 aphids from soybeans in a maximum during 24 hours at a density of 32 insects/cage.

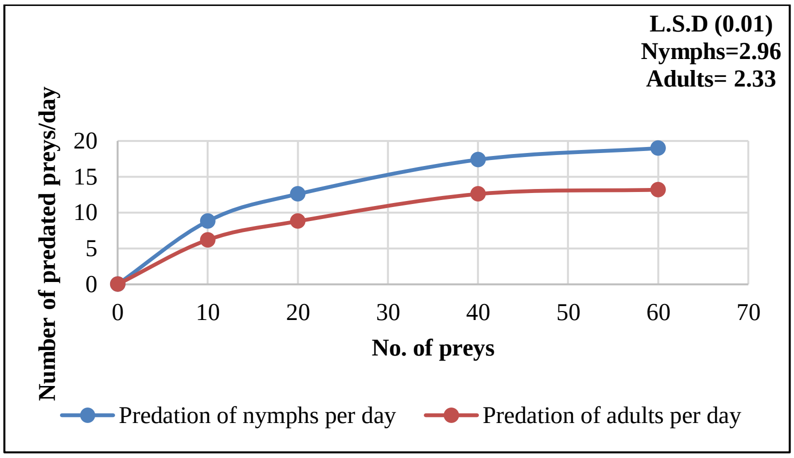

FIGURE 2. Predation of predator *O. albidipennis* adults on nymphs and adults of the green peach aphids.

The adult insects of the predator *Orius* spp. can prey on large numbers of preys under certain conditions, for example, the total average of soybean aphids and thrips predated by the predator *O. insidiosus* were 126.0 and 391.8, respectively [8]. Rutledge *et al*. [24] found that up to 10 soybean aphid insects were preyed upon by *O. insidiosus* in 24 hours. Bonte *et al*. (21) reported that *O. thripoborus* and *O. naivashae* adults preyed on 5.38 and 3.60 insects respectively from *M. persicae* nymphs at a density of 20 nymphs/plate within 24 hours. Fathi and Nouri-Ganbalani [17] showed that two *O. Minutus* and *O.niger* adults can prey on 191.46 and 282.28 onion thrips during their adult life. Rondon *et al*. [31] found that the predator *O. insidiosus* consumes an average of 5.7 insects from *Aphis gossypii* every 24 hours when insect density was 10 insects/plate. Butler and O'Neil [8] indicated that the maximum predatory efficiency of the predator *O. insidiosus* was 3.5 soybean aphids within 24 hours when the prey density was 12. However, high predation efficiency is not always an indicator of prey suitability. Mendes *et al*. [32] stated that high prey consumption may occur to fill a nutritional gap as a result of low-quality prey.

- **Feed préférence for O. albidipennis**

Each adult predator consumes a thrips nymphs aphids when introduced together (Figure 3), which indicates that the predator does not have a specific preference for prey. It also found that the consumption of onion thrips nymphs when presented as prey alone was significantly different from its consumption as a mixture with aphids. The consumption of thrips decreased significantly when aphids were present, as the predator consumed 23.3 insects / container when presenting thrips per unit and 15.4 insects / container in the prey mixture. While there were no significant differences in the consumption of aphids when presented alone or mixed with thrips nymphs, where the predator consumption was 14.8 insects / container in the first case and 11.6 insects / container in the second case, respectively.

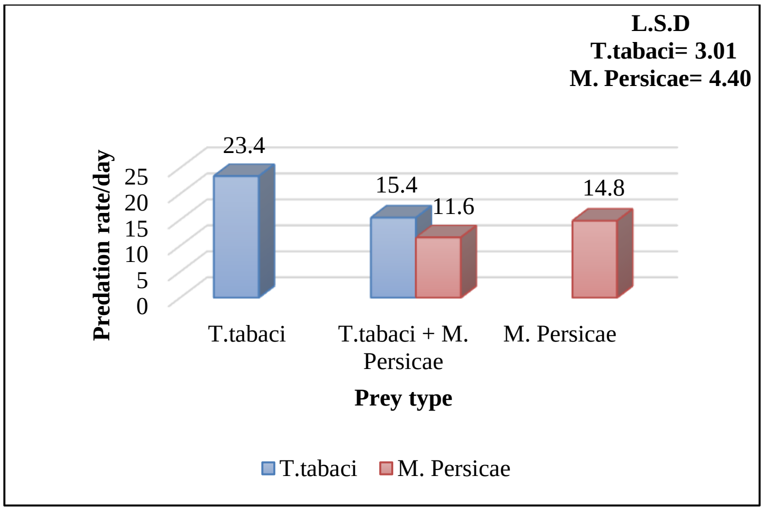

FIGURE 3. Number of prey consumed by adult predator *O. albidipennis* within 24 hours.

It is noted that the number of aphids that were preyed has not changed when it is present alone or mixed with thrips, and the predator consumes thrips nymphs in greater numbers than the nymphs of aphids when presented in a mixed manner. this is mostly due to the difference in the means of defense and movement ability of the two prey. It was observed that the aphids remain stationary even when the predator approaches, unlike the thrips, which begins to escape, which makes the thrips more visible to the predator. The predator's ability to detect prey, accessibility, prey defenses against predator and the predator's ability to feed effectively are four main factors that determine the ease with which a particular prey is attacked by a general predator [33].

These results are similar to those of several studies. Wittmann and Leather] 34 reported that the preference for *O.laevigatus* predator for two prey from *Amblyseius degenerance* and *Amblyseius cucumertis* was different due to behavioral differences between the prey, and *A. degenerance* was more mobile than *A. cucumertis*, as the predator has a greater ability to capture less active species. Several studies have indicated that the predator *Orius* spp. Is a polyphagous predator. Messelink *et al*. [15] found that the adult predator *O. majusculus* feeds on thrips as well as aphids, without clear preference, and that the presence of thrips enhances the presence of predators and thus controls aphids. Wang *et al*. [11] stated that the predator *O. sauteri* preys on the thrips, *F. occidentalis*, *M. persicae*, and three other types of aphids, and was able to develop and reproduce when the two insects were introduced as prey. Although the best developmental and reproductive performance of the predator was when feeding on thrips, *F. occidentalis*, *M. persicae* could represent an important alternative prey for the predator when thrips are rare. Neither insect negatively affected the numerical response of *O. sauteri* in biological control applications. Experiments of *O. niger* preference on three groups of prey in equal population showed a greater preference for *T. tabaci* and *A. gossypii* compared to *Tetranychus urticae*, and that consumption was not significantly affected by the number of *T. tabaci* and *A. gossypii* stages [19]. Butler and O'Nei [8] attributed the predator *O. insidiosus's* preference for attacking soybean thrips than attacking soybean aphids, regardless of relative prey density, to several reasons, including the predator's behavior in searching for food and identifying prey by sight. Soybean thrips were more visible to the predator, being more mobile and as a result they were attacked more often. The other reason was the defensive response of soybean aphid to predation, as aphids produce secretions from the corneal channels that lead to deterring or killing the predator.

Rutledge and O'Neil [10], Yoo and O'Neil [25,35], Harwood found that despite its preference for soybean thrips, the predator *O. insidiosus* attacks soybean aphid *A. glycines* at a very low density of 0.5 aphid per plant even when soybean thrips are available in the field. Moreover, the researchers reported that increasing the aphids' density also increased the proportion of *O. insidiosus* attacking aphids, indicating that the predator is tracking aphid densities. Butler and O'Neil [8], Butler and [36], O'Neil showed that the predator *O. insidiosus* is polyphagous and that thrips are highly prefered prey of the predator. Likewise, prey movement and defense tactics are important factors that the predator takes into account in choosing prey. Butler, O'Neil [37], Desneux, and O'Neil [38], recorded defensive mechanisms of *A. glycines* against *O. insidiosus* that were more pronounced and effective than those observed in *F. occidentalis*.

- **Evaluation of O. albidipennis ability to control and reduce M. persicae population**

The results of the statistical analysis in Fig. (4) showed that the predator *O. albidipennis* was able to reduce the population growth of green peach aphid compared to the population growth of aphid in the treatments in the absence of the predator, which started with numbers of 10, 20 and 30 adult insects/cage. However, treatments that started with numbers of 40 adults / cage did not differ in the increase in the number of aphids in the treatments with or without the predator, as the density of aphids after four days reached 118.4 and 135.2 insects / cage, respectively.

The low efficiency of the predator in controlling population increase of aphids when its density was starting at 40 insects / cage may be attributed to the increase in the accumulation of insects' exerment, honeydew and moulting skins on plant leaves, which impede the predator and increase the predator's searching period for prey, which affects the predator's efficiency. Aphids secrete via corneal ducts a fast-solidify, wax-like liquid droplet that is Tri acyle glecerol as a defense against predators [39], which can deter or kill a predator [37]. This is in accordance with Rutledge *et al* [24], Rutledge and O'Neil [25], reporting that the predator *O. insidiosus* is able to reduce the population growth of aphids in soybean at starting population densities 12, 24 and 48 adult / cage compared to the population growth of aphids in the absence of the predator. However, when the number of aphids was initially 64 adults/cage, the increase in the number of aphids was not significantly different between treatments with or without the predator.

Messelink *et al*. [15], stated that the predator *O. majusculus*, when present in sufficient densities, can play a major role in controlling aphids by rapidly responding to aphid infestation due to their continuous presence in the crop. Rutledge and O'Neil noted [25], Harwood *et al*. [35], Desneux *et al*. [40], indicated the potential of the predator *O.*

insidiosus to reduce the population growth of *A. glycines* at low numbers, and the importance of this predator as a biological control factor in the integrated management of soybean aphid. There was a significant negative relationship between aphid population growth and *O. insidiosus* abundance.

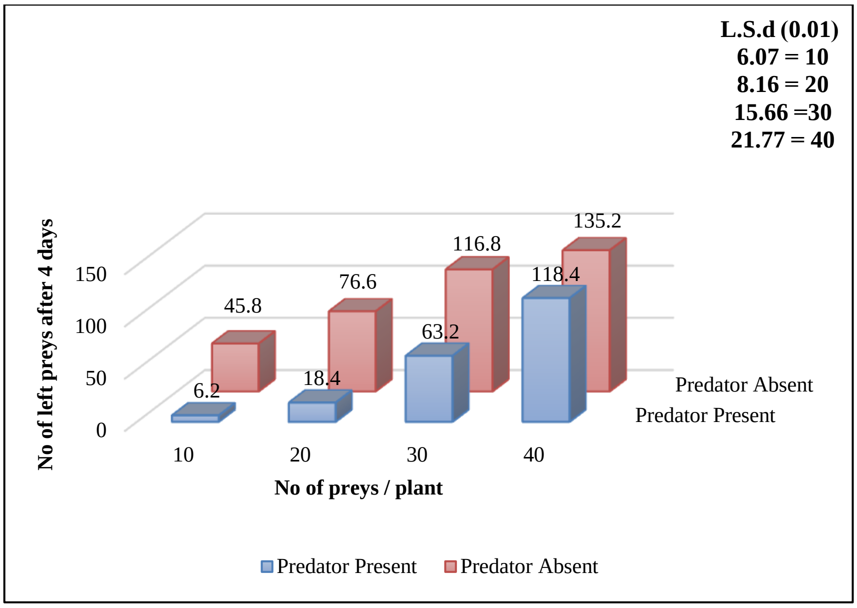

FIGURE 4. Average numbers of aphids after four days with the presence or absence of the predator *O. albidipennis.*

IV. CONCLUSION

The predatory bug, *Orius albidipennis* Reuter, is a common predator that preys on the onion thrips *T. tabac* and green peach aphid *M. persicae*. *O. albidipennis* has no clear food preference for one of the two prey when presented together as prey. The predator was also able to suppress the increase of aphid population on the carrot plants at low densities, but its predatory efficiency decreased by increasing the population density of aphids.

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