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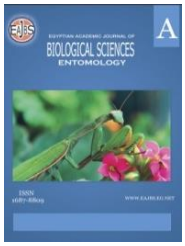

A Study on The Effect of Releasing the Two Common Predators; *Coccinella undecimpunctata* L. and *Chrysoperla carnea* Steph., on the Population Density of the Onion Thrips, *Thrips tabaci* (L.), attacking the Onion Plants in Greenhouses Located in Sohag Governorate.

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ABSTRACT

In Egypt, the onion plants (*Allium cepa* L.) is considered as one of the most important field crops that are continuously and extensively grown and they are also spread and cultivated un a large scale all over the world. It can be grown under a wide range of climatic conditions, but they do best in a mild climate that is characterized by no excessive rainfall or extreme temperature. The onion crop is subjected to attack by a lot of important sap-sucking insects' pests such as; the onion thrips, *Thrips tabaci* (L.) (Thysanoptera: Thripidae), which cause obvious damage to the resulted crop. Obtained results indicated that in the area of the greenhouses that were cultivated with the onion plants for the unreleased control, the mean total numbers of the onion thrips, *T. tabaci* individuals per season were; 26.6±2.9 (18.8-41.2) and 27.9±3.4 (18.2-42.3) individuals, for 2018 and 2019 seasons, respectively. While, in the case of the released area of the adults of the ladybird beetle, *Coccinella undecimpunctata* L. (Coloeptera: Coccinellidae), the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 27.3(18.2-42.3) individuals., with a mean percentage of reduction for the two seasons together of 68.80% (69.90-68.40%). But, in the case of the released area of the larvae of the green lacewing, *Chrysoperla carnea* (Steph.) (Neuroptera: Chrysopidae), the mean total of the onion thrips, *T. tabaci* individuals for the two seasons together was 8.0 (2.5-19.5) individuals, with a mean percentage of reduction for the two seasons together of 70.6% (69.9-71.7%). Therefore, the obtained results revealed the important role of releasing the two predators; the ladybird beetle, *C. undecimpunctata*, and the green lacewing, *C. carnea* as effective biocontrol agents against the onion thrips, *T. tabaci* on the onion plants. So, they can be released in onion fields and/or other related fields that suffer from the pest attack, in the frame of Integrated Pest Management (I.P.M.) strategies, for decreasing the uses of the chemical control methods, to avoid the hazards of these direct or the indirect insecticidal applications on the pollution of the environment.

INTRODUCTION

In Egypt, the onion plants (*Allium cepa* L.) are considered as one of the most important field crops that are continuously and extensively grown and they are also spread

and cultivated all over the world. It can be grown under a wide range of climatic conditions, but they do best in a mild climate that is characterized by no excessive rainfall or extreme temperature. They require cool, moist conditions for the early growth, followed by warm, drier conditions for the maturation, the harvest, and the curing (Purseglove, 1992). However, the onion plants are commonly called "the queen of the kitchen" and are deeply used for the feeding purpose all the year-round, besides their exportation. The onion plants are subjected to attack by a lot of important sap-sucking insects' pests such as; the onion thrips, *Thrips tabaci* (L.) (Thysanoptera: Thripidae) (Nault & Hessney, 2010). This pest is a cosmopolitan and a polyphagous sap-sucking insect pest (Kadri & Goud, 2006), which induces much severe damage to the onion plants by their feeding on the leaves making silvery areas. As a result, their infestation affects the quality of the yield crop of the onion plants and also their ability for the exportation purpose (Nault & Hessney, 2009). The attacked leaves become curled, wrinkled, and gradually dry up and when the infestation is severe, the size of the onion bulbs is reduced. Heavily infested plants do not form bulbs; neither do the flowers produce seeds (Atwal, 1976). Where, this pest is very active at the time of the flowering period adversely affecting both the yield and the viability of the onion seeds (Sing, 1984). Moreover, the thrips are implicated in the spread and the transmission of many plant diseases, where, their feeding may lead to the expansion of the deadly purple blotch disease (Adilakshmi *et al.,* 2008). Both the nymphs and the adults of the onion thrips, *T. tabaci* cause severe damage to the crop, which can reach 40-60% in the foliage damage and can lead to 10-20% annually yield losses (Waiganjo *et al.,* 2008), while, these percentages were also shown to be 30–50% (Nault & Shelton, 2012).

The use of the chemical insecticides for controlling the insects' pests has caused many environmental pollutions and hygienic problems that represent a risk for both people and animals (Gallo *et al.,* 2007), besides, the disruption that will occur in the natural balance that is existed between these pests and the common natural enemies (Ibrahim *et al.,* 2014). So, the need for reducing pesticide usage has been provided to search for effective's alternatives to conventional chemical pesticides (El-Akhadar & Ouda, 2009). Scientists had concentrated their efforts to use more safe control methods such as applying the biological control techniques. This field has received much crucial worldwide and revealed a significant impact as a possible way of insect control (Sabbour & Abbas, 2007). Now, it is considered an essential component of Integrated Pest Management (I.P.M.) programs (El-Sahn & Gaber, 2012), which is often recommended as the first defense line to face the menace of attacking economic pests (El-Zahi, 2012). However, many natural enemies such as predators (as one of the main components of the biological control agents) play a noticeable natural role against different insects' pests in agriculture (El-Khawas, 2005). These predators that belong to the family Coccinellidae (feed during the larval and the adults stages) and also those belonging to family Chrysopidae (that only feed during the larval stage), are common predators on many different sap-sucking pests including; aphids, whiteflies, jassids, and mites as well as other small insects (Shalaby *et al.,* 2008). From these predators, the coccinellid predator *Coccinellina undecimpunctata* L. was recorded as an effective biocontrol agent against many insects' pests where, it is shown as an interesting potential control agent in the context of I.P.M. (Cabral *et al.,* 2008). Moreover, the green lacewing larval predator, *Chrysoperla carnea* Steph. (Neuroptera: Chrysopidae), represent one of the most predators, which is quite common in the agricultural ecosystems in most of the world countries and has received great attention in the field of biological control (Atallah *et al*., 2009). These predatory larvae are polyphagous that feed upon a wide range of pests' species such as; aphids, whiteflies, mealy bugs, scale insects, thrips, leafhoppers, psyllidae, psocides, lepidopterans, and mites (Remoldi *et al*., 2008), but, the green lacewing adults of *C. carnea* feed on the pollen, the nectar or the honey (Abdel-Samad, 2011).

So, the present work was carried out to study the effect of releasing the adults of the coccinellid ladybird *C. undecimpunctata* and also the larvae of the green lacewing, *C. carnea* for controlling the onion thrips, *T. tabaci* on the onion plants, during the two successive seasons 2018 and 2019, in Sohag Governorate. Such information can help in planning I.P.M. strategies, side by side with other safe control methods against the onion thrips, *T. tabaci* on the onion plants or other plants that are subjected to attack by this insect pest species.

MATERIALS AND METHODS

The period of the tested experiments in this study was chosen, where, the onion thrips, *T. tabaci* was previously shown to be very active at the time of the flowering period, adversely affecting both the crop yield and the viability of the onion seeds (Sing, 1984), and also, when the onion crop is approaching its maturity (Alston & Drost, 2008). So, the present study was carried out in different tested areas under the greenhouses located in Shandaweel Agricultural Research Station (Sohag Governorate), during the two successive growing seasons 2018 and 2019, that were cultivated with the onion plants (variety Giza 6 Mohasan) (Fig.1A), during the period of the onion plants flowering (Fig.1B).

A- The Source of The Released Biological Control Agents (The Two Predators: The Adults of The Ladybird Beetle, *C. Undecimpunctata,* and the Larvae of The Green Lacewing, *C. Carnea*):

Two released areas representing; the areas of releasing the two common predatory species; the adults of the coccinellid predator, *C. undecimpunctata,* and the larvae of the green lacewing, *C. carnea* which were compared to the unreleased control area (no predators were released in this area). These two predatory species (the two predators: the adults of the ladybird beetle, *C. undecimpunctata,* and the larvae of the green lacewing, *C. carnea*), were obtained from the Biodynamic Agriculture Services Center of the High Dam Lake Settlement Project Dependent, Ministry of Egyptian Agriculture at Aswan Governorate.

1- A total number of 50 pairs (100 males and females adults, in four cups; i.e., 25 adults in each plastic used cups, indicating that 12 cups (each cup 4.5×5.5), were used for the experiment concerning the ladybird predator, *C. undecimpunctata*). I.e., a total of 300 adults' predators were used for the experiment concerning the release of this predator.

2- As for the predatory larvae of the green lacewing, *C. carnea* that were used for the released purpose, 50 predatory larvae were put in small paper bugs that were feed on a cart containing glued of the lesser grain moth *Sitotroga cerealella* eggs on one cart. I.e., each cage contains 100 predatory larvae (50 predatory larvae×2carts), so a total of 300 predatory larvae of the green lacewing, *C. carnea* (100 predatory larvae of the green lacewing, *C. carnea* ×3 areas as replicates) were used (Fig., 2).

B- The Steps of Performing the Released Experiments in Comparing with The Unreleased Control One:

The following steps were followed for carrying out the experiments in this study:

1- The experimental areas (The total cultivated onion areas were $144m^2$ (= 12m×12m), representing three equal greenhouses each of $48m^2$ (= 3×4m×4m)) (Fig., 3). The tested areas were located under the greenhouses that were cultivated in the first weeks of December 2018 & 2019, where these areas were annually chosen for the sampling purpose (Fig.3), during the period of onion plants flowering that was in the first weeks of April 2018 & 2019. Where these investigated areas received all the recommended agricultural practices throughout the whole growing seasons, expect the chemical insecticides which were entirely avoided. Each greenhouse contains three areas, where each area was$16m^2$ (=4m×4m). Where each area contains seven double rows; the distance of each of the rows was 25cm (7 rows×25cm, representing the total distance of the seven double rows that was 175m). While the distance

between the double rows was 225cm(400cm-175cm)=(6 distances×37.5 cm), and the distance between each double row to the other one was 225/6 distance=37.5cm.

2- The total numbers of the onion plants in each double row were 32 onion plants (16 plants for every single side of the double row×2 sides of the double row) .I.e., the total cultivated onion plants for each experiment was 672 onion plants (=32 onion plants/double row×7 double rows for each area×3 areas as replicates).Therefore, the total cultivated onion plants were 672×3experimental areas=2016 onion plants, where, the distance between each plant to the other one was 25cm.

3-The two released areas representing; the areas of releasing the two common predatory species; the adults of the coccinellid predator, *C. undecimpunctata* and the larvae of the green lacewing, *C. carnea* were compared to the unreleased control, where, these two predatory species were both released for only one time in 12/4/2018 in the first season 2018 and in 10/4/2019 in the second season 2019.

4- Sampling were done early in the morning on the onion flowers during the month of April, where, it began at the second weeks of April and continued till the last weeks of April (at the full maturity of the onion seeds at the beginning of the onion seeds harvest time), in the two successive seasons 2018 and 2019 (Fig., 4). Random regular samples of 10 onion plants were carefully examined from each double row, i.e., 30 plants were examined for each sample for each case. So, a total of 90 plants were examined in case the three cases; the unreleased control area, the released area of the adults of the ladybird predator, *C. undecimpunctata,* and the release area of the larvae of the green lacewing predator, *C. carnea*. Where, the onion thrips, *T. tabaci* individuals were collected in plastic cups and brought to the laboratory where, the total numbers of the onion thrips, *T. tabaci* were recorded and counted throughout the two successive growing onion seasons, 2018 and 2019. The percentages of reduction of the onion thrips, *T. tabaci* individuals in the two released areas of the two common predatory species (the adults of the coccinellid ladybird predator, *C. undecimpunctata,* and the larvae of the green lacewing, *C. carnea*), were calculated by comparing them with that of the onion thrips, *T. tabaci* individuals in the unreleased control. The percentages of reduction in the mean total numbers of the onion thrips, *T. tabaci*, attacking the onion plants were calculated according to the following equation:

% of reduction in the mean total numbers of the onion thrips, *T. tabaci* =100 - Total no. of the onion thrips, *T. tabaci* in either the released area of the ladybird *C. undecimpunctata* or that of the lacewing predator *C. carnea* / Total no. of the onion thrips, *T. tabaci* individuals in the unreleased control area (no predators release) × 100

5- Moreover, the mean total weights (grams) of the resulted seeds of the onion crop were calculated and compared for the two tested released areas of the two common predatory species (the adults of the coccinellid ladybird predator, *C. undecimpunctata* and the larvae of the green lacewing, *C. carnea*), were calculated by comparing them with that of the unreleased control. A total of 5 onion seeds were weighted for each replicate (i.e., 5 seeds/replicates×3 replicates=15 onion seeds for each case). Therefore, a total of 45 seeds (3 cases×5 seeds/replicates×3 replicates) were weighted and the mean total weights (grams) were estimated (for the three tested cases; the unreleased areas, the released areas of the adults of the coccinellid, *C. undecimpunctata* and the released areas of the green lacewing larvae of *C. carnea*).

6- The obtained data were tabulated and statistically analyzed to calculate the means and the r-values (correlation coefficient) by using SPSS program version (15.0.). The weather factors including the means of temperatures and the means of the relative humidity were obtained from the Meteorological Station at A.R.C.

Fig. (1): The experimental areas that were cultivated with the onion plants, in greenhouses located in Sohag Governorate.(**A**)The greenhouses in which the onion plants were cultivated. **(B**)The period of the onion plants flowering at which the three experiments were made.

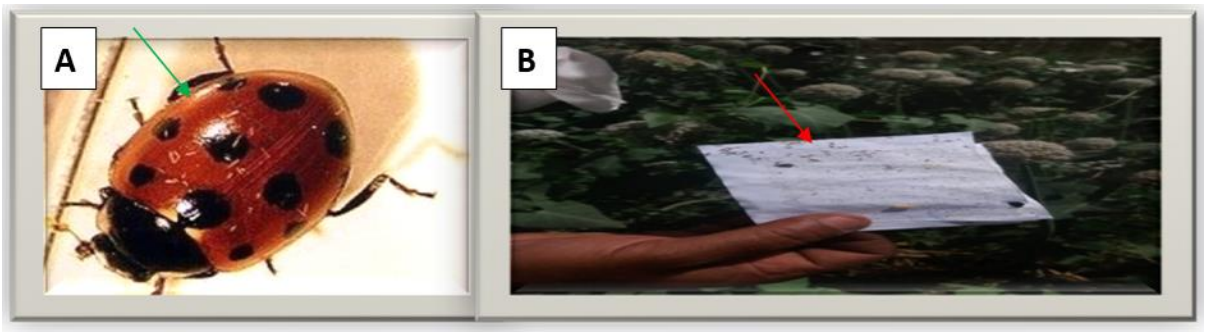

Fig. (2): The release of the two common predators; *C. undecimpunctata* adult in a cup **(A)** and the green lacewing larvae of *C. carnea* in a paper cart **(B),** in the experimental areas of the greenhouses, during the two successive seasons 2018 and 2019, in Sohag Governorate.

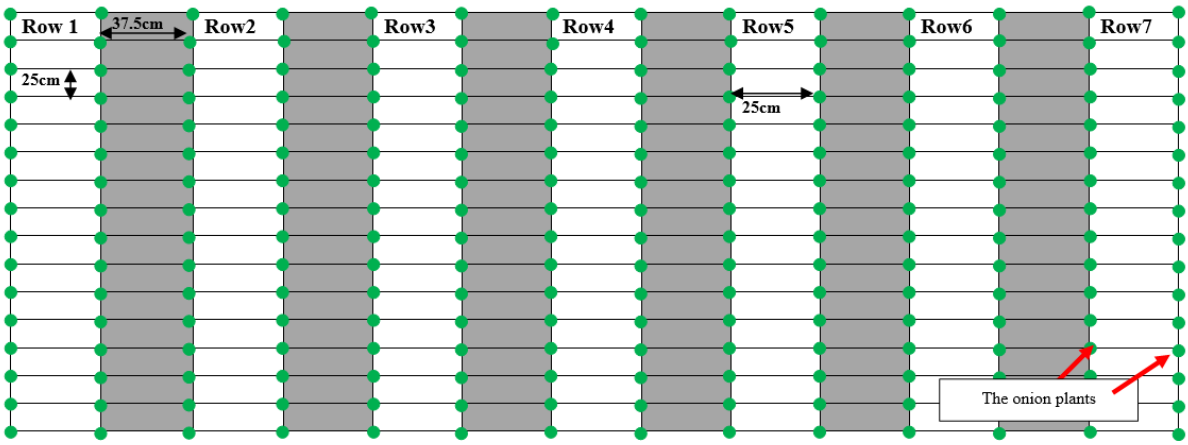

Fig. (3): A diagram that represent the design of each of the experimental cage that was used for the experiment purpose.

Fig. (4): The damage occurred to bulbs of the onion plants by the infestation with the onion thrips, *T. tabaci*.

RESULTS AND DISCUSSION

Data presented in Tables (1, 2&3) and Fig. (4), showed the effect of; releasing the adults of the coccinellid ladybird, *C. undecimpunctata,* and the larvae of the green lacewing, *C. carnea* on the onion plants for controlling the onion thrips, *T. tabaci,* during the two successive seasons 2018 and 2019, in greenhouses located in Sohag Governorate.

1-The Population Density of The Onion Thrips, *T. Tabaci* Individuals in The Unreleased Control Area:

As shown in Table (1) and Fig. (4), in season 2018, the onion thrips, *T. tabaci* individuals started to appear with a mean low number of the three tested areas (19.5 individuals), on 9/4/2018 (at means the temperature of 19.8cº & means of the relative humidity of 57.5 %). Then, it reached the maximum mean total number (41.2 individuals) in 21/4/2018 (at 29.0cº & 27.2%). Finally, there was a decrease with a mean low total number (18.8 individuals) in 30/4/2018 (at 30.3cº & 18.7 R.H. %). As for season 2019, the onion thrips, *T. tabaci* individuals started to appear with a mean low number of the three tested areas (19.3 individuals), in 8/4/2019 (at 20.3cº & 42.1 R.H. %). After that, they reached the maximum mean total number (42.4 individuals) in 22/4/2019. Finally, a decrease in the mean total number (19.3 individuals) occurred in 28/4/2019. The mean total numbers of the onion thrips, *T. tabaci* individuals per season were; 26.6±2.9 (18.8-41.2) and 27.9±3.4 (18.2-42.3) individuals, for 2018 and 2019 seasons, respectively. While, the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 27.3(18.2-42.3) individuals.

Table 1: The mean total numbers of the onion thrips, *T. tabaci* individuals that were recorded in the unreleased control area, in the three experimental areas of the greenhouses that were cultivated with the onion plants, during the two successive seasons 2018 and 2019, located in Sohag Governorate.

Seasons	Dates of samples investigation	Mean total no. of the onion thrips, *T. tabaci* individuals				Weather factors	
		Area 1	Area 2	Area 3	Mean total no./one day	Mean cº	R.H.%
2018	9/4/2018	19.1	20.0	19.6	19.5	19.8	57.5
	12/4	18.8	18.6	19.3	18.9	27.1	29.0
	15/4	27.4	26.9	26.5	26.9	27.2	26.5
	18/4	32.9	33.3	29.1	31.7	28.9	28.4
	21/4	40.4	41.8	41.4	41.2	29.0	27.2
	24/4	35.4	30.7	32.8	32.9	22.7	36.7
	27/4	24.6	23.7	20.3	22.8	24.3	29.1
	30/4	16.2	19.4	20.8	18.8	30.3	18.7
Mean/season		26.9±3.1 (16.2-40.4)	26.8±2.9 (18.6-41.8)	26.2±2.8 (19.1-41.4)	26.6±2.9 (18.8-41.2)	26.2 cº (19.8-30.3 cº)	31.6% (18.7-57.5%)
2019	8/4/2019	19.2	19.2	19.7	19.3	20.3	42.1
	10/4	18.1	18.4	18.1	18.2	19.7	43.6
	13/4	25.2	25.7	27.3	26.0	25.5	26.5
	16/4	32.0	32.3	32.5	32.3	22.7	42.5
	19/4	39.4	40.5	41.4	40.4	21.4	43.3
	22/4	45.2	40.5	41.1	42.3	17.4	40.7
	25/4	28.2	24.6	23.7	25.5	25.4	28.6
	28/4	20	19.5	18.5	19.3	26.7	31.6
Mean/season		28.4±3.5 (18.1-45.2)	27.6±3.2 (18.4-40.5)	27.8±3.4 (18.1-41.4)	27.9±3.4 (18.2-42.3)	22.4 cº (17.4-26.7)	37.4% (26.5-43.6%)
Mean /2 seasons		27.7 (16.2-45.2)	27.2 (18.6-41.8)	27.0 (18.1-41.4)	27.3 (18.2-42.3)	24.3 cº (17.4-30.3 cº)	34.5% (18.7-26.5%)
- Statistical analysis: A comparison between the two seasons 2018 & 2019, in case the mean total numbers of the onion thrips, *T. tabaci* individuals: a very highly significant was obtained between the two studied seasons (where the r-value was 0.935****&sig. =0.001).							

Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900.

The onion thrips, *T. tabaci* was recorded as a pest of the onion plants by many authors such as; Alston & Drost (2008) and Nault *et al.* (2012). However, although the chemical control might provide satisfactory results, it is undesirable for the occurrence of the insecticidal residual problem and also it can interfere with the biological control methods of the target control pests (Shipp, *et al.* 1991). So, an effective biological control program can solve some of this problem for the onion thrips, *T. tabaci* damage, and therefore, it is necessary to be applied and is strongly needed (Ulubilir & Yabas, 1996).

Statistical analysis of the obtained data by making a comparison between the two seasons 2018 & 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals indicated that a very highly significant was obtained between the two studied seasons (where the r-value was 0.935****&sig. =0.001).

2- Releasing the Ladybird Adults' Predator, *C. undecimpunctata* against the Onion Thrips, *T. tabaci*:

As shown in Table (2) and Fig. (4), in season 2018, the onion thrips *T. tabaci* individuals started to appear with a mean low number of the three tested areas (19.6 individuals), in 9/4/2018. After that, they reached the maximum mean total number (20.3 individuals) in 12/4/2018. Finally, a decrease in the mean total number (0.5 individuals) occurred in 30/4/2018. As for the successive season 2019, the onion thrips, *T. tabaci* individuals started to appear with a mean low number of the three tested areas (19.3 individuals), in 8/4/2019. After that, they reached the maximum mean total number (19.3 individuals) 8/4/2019. Finally, a decrease in the mean total number of the onion thrips, *T. tabaci* (0.4 individuals) was recorded on 28/4/2019. The mean total numbers of the onion thrips, *T. tabaci* individuals per season were; 8.5±2.7 (0.5-20.3) and 8.4±2.6 (0.4-19.3), for 2018 and 2019 seasons, respectively. However, the mean total numbers of the onion thrips, *T. tabaci* individuals for the two seasons together was 8.5(0.4-20.3) individuals. The percentage of the reduction of the onion thrips, *T. tabaci* individuals in areas in which the ladybird predatory adults of *C. undecimpunctata* were released in comparison with that of the unreleased control areas was 69.90% in season 2018 and 68.40% in season 2019. While, the mean percentage of the reduction of the onion thrips, *T. tabaci* individuals for the two seasons together was 68.80% (69.90-68.40%). As a result, from the obtained data it was recorded that, the percentage of reduction of the onion thrips, *T. tabaci* individuals was relatively higher in the first season (2018) in comparing with that occurred in the second one (2019). Statistical analysis of the obtained data by making a comparison between the two seasons 2018 & 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals, by comparing the released area of the ladybird beetle, *C. undecimpunctata* indicated that a very highly significant was obtained (where the r-value was 0.993**** & sig. =0.000). A comparison of the season 2018, in case the mean total numbers of the onion thrips, *T. tabaci* individuals, by comparing the unreleased control area and the released area of the coccinellids ladybird, *C. undecimpunctata* revealed that no significant difference was obtained (where the r-value was -0.383 & sig.=0.349). A comparison of the successive season 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the ladybird beetle, *C. undecimpunctata* showed that no significant difference was obtained (where, the r-value was -0.442&sig.=0.272).

However, many investigators such as Benrey & Lamp (1994) showed that, in agricultural systems, the use of the natural enemy complexes, as opposed to a single enemy strategy, has been a controversial issue in the management and the biological control of pests. Aphidophagous ladybird beetles have been receiving attention as biological control agents due to some of their characteristics, such as the ability to feed on a wide range of prey, to be very voracious, and to have a rapid numeric response (Dixon, 2000). The

predators that belong to the family Coccinellidae comprise one of the most active groups of predatory species that gained the interest of many investigators as an important group of the predator in the biological control of insect pests attacking different crop plants (Bahy El-Din, 2006). The eleven-spotted coccinellid beetles, *C. undecimpunctata* have extensive dispersal power on the majority of field crops (Khan & Suhail, 2001).

Table 2: The mean total numbers of the onion thrips, *T. tabaci* individuals that were recorded in the ladybird, C. *undecimpunctata* area, in the three experimental areas of the greenhouses that were cultivated with the onion plants during the two successive onion seasons 2018 and 2019, located in Sohag Governorate.

Seasons	Dates of samples investigation	Mean total no. of the onion thrips, *T. tabaci* individuals			
		Area 1	Area 2	Area 3	Mean total no./one day
2018	9/4/2018	19.1	20.0	19.6	19.5
	12/4*	20.7	20.2	20.0	20.3
	15/4	9.8	10.2	11.0	10.3
	18/4	8.7	7.4	8.8	8.3
	21/4	5.7	4.6	4.6	4.9
	24/4	2.7	3.1	2.7	2.8
	27/4	1.5	1.4	1.8	1.6
	30/4	0.6	0.4	0.6	0.5
Mean/season		8.6±2.7(0.6-20.7)	8.4±2.8(0.4-20.2)	8.6±2.7(0.6-20.0)	8.5±2.7(0.5-20.3)
2019	8/4/2019	19.2	19.2	19.3	19.3
	10/4*	17.3	19.1	18.1	18.1
	13/4	11.2	10.6	10.8	10.8
	16/4	7.9	7.8	7.9	7.9
	19/4	5.3	5.6	6.3	6.3
	22/4	2.9	2.8	3.0	3.0
	25/4	1.3	1.2	1.4	1.4
	28/4	0.5	0.3	0.4	0.4
Mean/season		8.2±2.5(0.5-19.2)	8.3±2.6(0.3-19.2)	8.6±2.5(0.4-19.7)	8.4±2.6(0.4-19.3)
Mean/2 seasons		8.4(0.5-20.7)	8.3(0.3-20.2)	8.6(0.4-20.0)	8.5(0.4-20.3)
% reduction in comparison to unreleased control:					
In season 2018		68.00%	55.48%	36.18%	69.90%
In season 2019		70.30%	69.90%	68.8%	68.40%
Mean % of reduction/2 seasons		69.15% (68.00-70.30%)	69.50% (55.48-69.90%)	68.10% (68.80-68.10%)	68.80% (69.90-68.40%)
- Statistical analysis by making a comparison between the two seasons 2018 & 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals, by comparing the released area of the ladybird beetle, *C. undecimpunctata* indicated that a very highly significant was obtained (where the r-value was 0.993**** & sig. =0.000). A comparison of the season 2018, in case the mean total numbers of the onion thrips, *T. tabaci* individuals, by comparing the unreleased control area and the released area of the coccinellids ladybird, *C. undecimpunctata* revealed that no significant difference was obtained (where the r-value was -0.383 & sig.=0.349). A comparison of the successive season 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the ladybird beetle, *C. undecimpunctata* showed that no significant difference was obtained (where, the r-value was -0.442&sig.=0.272).					

* Date of predator release. Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900

3- Releasing of the Green Lacewing Predator, *C. carnea* against the Onion Thrips, *T. tabaci*:

As shown in Table (3) and Fig. (4), in season 2018, the onion thrips, *T. tabaci* individuals started to appear with a mean low number of the three tested areas (19.5 individuals) on 9/4/2018. Then, they reached the maximum mean total number (19.5 individuals) in 9/4/2018. Finally, they decreased with a mean low total number (2.5 individuals) in 24/4/2018. As for the successive season 2019, the onion thrips, *T. tabaci* individuals started to appear with a mean low number of the three tested areas (19.3 individuals), in 8/4/2019. Then, they reached the maximum mean total number (19.3 individuals) 8/4/2019. Finally, they decreased in a mean low total number of the onion thrips, *T. tabaci* individuals (2.5 individuals) in 22/4/2019. The mean total numbers of the onion thrips, *T. tabaci* individuals per season were; 8.0±2.5 (2.5-19.5) and 7.9±2.6 (2.5-19.3), for 2018 and 2019 seasons, respectively, while, the mean total for the two seasons together was 8.0 (2.5-19.5) individuals. In season 2018, the percentage of reduction in the mean total number of the onion thrips, *T. tabaci* individuals was 69.9% in the released area of the larvae

of the green lacewing, *C. carnea* in comparing with the unreleased control area. In the successive season 2019, the mean percentage of reduction in the mean total number of the onion thrips, *T. tabaci* individuals was 71.7. While, the mean percentage of reduction in the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 70.6% (69.9-71.7%).

Table 3: The mean total numbers of the onion thrips, *T. tabaci* individuals that were recorded in the green lacewing, *C. carnea* area, in the three experimental areas of the greenhouses that were cultivated with the onion plants during the two successive onion seasons 2018 and 2019, located in Sohag Governorate.

Seasons	Dates of samples investigation	Mean total no. of the onion thrips, *T. tabaci* individuals			
		Area 1	Area 2	Area 3	Mean total no./one day
2018	9/4/2018	19.1	20.0	19.6	19.5
	12/4*	18.3	19.0	19.0	18.7
	15/4	8.5	8.4	9.6	8.8
	18/4	4.7	4.7	5.0	4.8
	21/4	3.3	3.1	3.4	3.2
	24/4	2.5	2.7	2.5	2.5
	27/4	3.3	3.4	2.9	3.2
	30/4	2.9	3.6	2.8	3.1
Mean/season		7.8±2.5(2.5-19.1)	8.1±2.6(2.7-20.0)	8.1±2.6(2.5-19.6)	8.0±2.5(2.5-19.5)
2019	8/4/2019	19.2	19.7	19.3	19.3
	10/4*	22.0	19.0	19.4	18.1
	13/4	7.7	8.6	8.4	10.8
	16/4	4.8	5.2	4.9	7.9
	19/4	2.7	3.1	2.9	6.3
	22/4	2.4	2.6	2.5	3.0
	25/4	2.9	3.1	2.7	1.4
	28/4	2.7	2.5	2.8	0.4
Mean/season		7.6±2.5(2.1-19.2)	8.1±2.8(2.4-19.2)	7.9±2.6(2.5-19.7)	7.9±2.6(2.5-19.3)
Mean/2 seasons		7.7(2.1-19.2)	8.1(2.4-20.0)	8.0(2.5-19.7)	8.0(2.5-19.5)
% reduction in comparison to unreleased control:					
In season 2018		71.0%	69.7%	69.1%	69.9%
In season 2019		73.2%	70.6%	71.6%	71.7%
Mean % of reduction/2 seasons		72.2% (71.0 -73.2%)	70.2% (69.7-70.2%)	70.4% (69.1-71.6%)	70.6% (69.9-71.7%)
- Statistical analysis of the obtained data indicated that by making a comparison between the two seasons 2018 & 2019: in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the released area of the larvae of the green lacewing, *C. carnea* showed that, a very highly significant was obtained (where the r-value was 0.999****& sig. =0.000). A comparison of the season 2018, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the larvae of the green lacewing, *C. carnea* indicated that a significant difference was obtained (where the r-value was -0.0560* &sig.=0.148). A comparison of the successive season 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the larvae of the green lacewing, *C. carnea* demonstrated that a moderate significant was obtained (where the r-value was -0.628**& sig.=0.096).					

* Date of predator release. Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900.

Statistical analysis of the obtained data indicated that by making a comparison between the two seasons 2018 & 2019; in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the released area of the larvae of the green lacewing, *C. carnea* showed that, a very highly significant was obtained (where the r-value was 0.999****& sig. =0.000). A comparison of the season 2018, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the larvae of the green lacewing, *C. carnea* indicated that a significant difference was obtained (where the r-value was -0.0560* &sig.=0.148). A comparison of the successive season 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the larvae of the green lacewing, *C. carnea* demonstrated that a moderate significant was obtained (where the r-value was -0.628**& sig.=0.096).

The green lacewing, *C. carnea* is a polyphagous predator, commonly found in the agricultural systems. It has been recorded as an effective predator, where its larvae is a generalist predator of a wide range of pests' species; including aphids, thrips, whiteflies,

immature scales, and mealybugs, while the adults of the lacewings are free-living that feed on the honeydew and the pollen grains (Yuksel & Goemen, 1992 and Saminathan & Baskaran, 1999).

Fig. (4): The mean total numbers of the onion thrips, *T. tabaci* that were recorded in the three experimental areas of the greenhouses that were cultivated with the onion plants, during the two successive seasons 2018 and 2019, located in Sohag Governorate.

4- The Effect of Releasing the Two Predatory Species; *C. undecimpunctata* and *C. carnea* Against the Onion Thrips, *T. tabaci* on The Resulted Onion Seeds Crop Yield:

Table (4) showed the effect of releasing the two predatory species; the ladybird beetle, *C. undecimpunctata,* and the larvae of the green lacewing, *C. carnea* against the onion thrips, *T. tabaci*, on the resulted onion seeds crop yield (grams). These obtained data were tabulated and were recorded for; the three experimental areas of the greenhouses that were

cultivated with the onion plants, during the two successive seasons 2018 and 2019, in Sohage Governorate. However, from the obtained results, the mean total weights of the resulted seeds crop for season 2018 were: 6.47±0.12, 23.38±0.25, and 25.32±0.78gm, in the case of the unreleased control area, the released areas of the ladybird beetle, *C. undecimpunctata,* and the released areas of the larvae of the green lacewing *C. carnea*, respectively. The corresponding values for the successive season 2019 were; 5.77±0.37, 24.70±0.50, and 26.30±0.75gm, respectively. The mean total weights for the two seasons together were; 6.12 (5.27-6.64), 24.09 (22.88-25.55), and 25.73 (23.89-26.57gm), respectively. Therefore, the mean weights of the resulted onion seeds crop yield (grams) were arranged as; the released areas of the larvae of the green lacewing *C. carnea* > the released areas of the ladybird beetle, *C. undecimpunctata* > the unreleased control area.

Table 4: The effect of releasing the two predatory species; *C. undecimpunctata* and *C. carnea* against the onion thrips,*T. tabaci* on the resulted onion crop yield (the weights of the onion seeds/grams) that were compared with the unreleased control area (in the three experimental areas of the greenhouses) that were recorded in the cultivated onion plants during the two successive onion seasons 2018 and 2019, located in Sohag Governorate.

Tested factors	Areas 1		Areas 2		Areas 3		Mean/3 areas/season		Mean/ 2seasons
	2018	2019	2018	2019	2018	2019	2018	2019	
- Unreleased control (no predators release).	6.23	5.55	6.64	6.50	6.53	5.27	6.47±0.12 (6.23-6.64)	5.77±0.37 (5.27-6.50)	6.12 (5.27-6.64)
- The release of the ladybird adults of *C. undecimpunctata.*	23.58	23.82	22.88	24.73	23.67	25.55	23.38±0.25 (22.88-23.67)	24.70±0.50 (23.82-25.55)	24.04 (22.88-25.55)
- The release of the green lacewing larvae of *C. carnea.*	23.89	26.93	26.57	26.84	25.49	24.63	25.32±0.78 (23.89-26.57)	26.13±0.75 (24.63-26.93)	25.73 (23.89-26.57)
- Statistical analysis of the obtained data showed that in season 2018; a comparison between the unreleased control area and the released area of the ladybird beetle, *C. undecimpunctata*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals, a moderate significant was obtained (where the r-value was -0.630**&sig.=0.566). Besides, a comparison between the unreleased control area and the released area of the larvae of the green lacewing, *C. carnea*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals, showed that a very highly significant was obtained (where the r-value was 0.989****&sig. = 0.095). Finally, a comparison between the released area of the ladybird beetle, *C. undecimpunctata,* and that released area of the green lacewing, *C. carnea*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals showed that a moderate significant was obtained (where the r-value was -0.739**&sig. =0.471). While, the following were obtained in the successive season 2019; a comparison between the unreleased control area and the released area of the adults of the ladybird beetle, *C. undecimpunctata*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals showed that no significant difference was obtained (where the r-value was -0.188&sig. =0.880). Besides, a comparison between the unreleased control area and the released area of the larvae of the lacewing, *C. carnea*, in the case of the mean total numbers of the onion thrips, *T. tabaci* individuals showed that a moderate significant was obtained (where the r-value was 0.650**&sig.=0.549). While, a comparison between the ladybird beetle, *C. undecimpunctata,* and the larvae of the green lacewing, *C. carnea,* by comparing the mean total numbers of the onion thrips, *T. tabaci* individuals showed that a moderate significant was obtained (where the r-value was -0.868***&sig.=0.330).									

Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900.

Statistical analysis of the obtained data showed that in season 2018; a comparison between the unreleased control area and the released area of the ladybird beetle, *C. undecimpunctata*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals, a moderate significant was obtained (where the r-value was -0.630**&sig.=0.566). Besides, a comparison between the unreleased control area and the released area of the larvae of the green lacewing, *C. carnea*, in case of the mean total

numbers of the onion thrips, *T. tabaci* individuals, showed that a very highly significant was obtained (where the r-value was 0.989****&sig. = 0.095). Finally, a comparison between the released area of the ladybird beetle, *C. undecimpunctata*, and that released area of the green lacewing, *C. carnea*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals showed that a moderate significant was obtained (where the r-value was -0.739**&sig. =0.471). While, the following were obtained in the successive season 2019; a comparison between the unreleased control area and the released area of the adults of the ladybird beetle, *C. undecimpunctata*, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals showed that no significant difference was obtained (where the r-value was -0.188&sig. =0.880). Besides, a comparison between the unreleased control area and the released area of the larvae of the lacewing, *C. carnea*, in the case of the mean total numbers of the onion thrips, *T. tabaci* individuals showed that a moderate significant was obtained (where the r-value was 0.650**&sig.=0.549). While, a comparison between the ladybird beetle, *C. undecimpunctata* and the larvae of the green lacewing, *C. carnea*, by comparing the mean total numbers of the onion thrips, *T. tabaci* individuals showed that a moderate significant was obtained (where the r-value was -0.868***&sig.=0.330).

5- The Relationships Between Many Tested Factors and The Weather Factors Concerning the Means of The Temperatures and The Means of Relative Humidity, That Were Recorded During the Two Successive Seasons 2018 And 2019, In the Greenhouses in Sohag Governorate:

The relationships between many tested factors and the weather factors concerning the means of the temperatures and the means of relative humidity, that were recorded during the two successive seasons 2018 and 2019, in the greenhouses in Sohag Governorate were recorded. Data obtained in Table (5) showed the relationships that were occurred between the mean total numbers of the onion thrips, *T. tabaci* individuals in the unreleased control area, the mean total numbers of the onion thrips, *T. tabaci* individuals in the released area of the ladybird beetle, *C. undecimpunctata*, the mean total numbers of the onion thrips, *T. tabaci* individuals in the released area of the larvae of the green lacewing, *C. carnea*, with the means of the temperatures and the means of the relative humidity.

Table 5: The relationships between many tested factors and the weather factors concerning the means of temperatures and the means of the relative humidity, during the two successive seasons 2018 and 2019, in the greenhouses located in Sohag Governorate.

Tested factors		2018		2019	
		Cº	R.H.%	Cº	R.H.%
1- The mean total numbers of the onion thrips, *T. tabaci* individuals in the unreleased control area.	r- value	0.228	0.158	0.408	0.281
	Sig.	0.588	0.709	0.315	0.500
2- The mean total numbers of the onion thrips, *T. tabaci* individuals in the released area of *C. undecimpunctata*.	r- value	0.350	0.564*	0.424	0.441
	Sig.	0.395	0.146	0.295	0.271
3- The mean total numbers of the onion thrips, *T. tabaci* individuals in the released area of *C. carnea*.	r- value	0.428	0.596*	0.387	0.357
	Sig.	0.291	0.119	0.356	0.386

Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900.

Statistical analysis of the obtained data showed that there were only significant differences between the mean total numbers of the onion thrips, *T. tabaci* individuals in both the released area of the ladybird beetle, *C. undecimpunctata*, and in the released area of the larvae of the green lacewing, *C. carnea*, with the means of the relative humidity, in case of the first season 2018 only.

However, similar to the obtained results, Domiciano *et al.* (1993) evaluated the population fluctuation of the onion thrips, *T. tabaci* on the onion plants at the three sowing times, and the relation with the climatic elements, as well as the best time for its control. The thrips population was recorded to correlate negatively with the relative humidity and also positively with the temperature.

CONCLUSION

1- For the three compared tested experimental cases: the unreleased control areas, in the released areas of the coccinellid predator, *C. undecimpunctata* and the larvae of the green lacewing, predator *C. carnea*; the onion thrips, *T. tabaci* individuals started to appear with a mean low number in the second weeks of April. Then, they reached the maximum mean total numbers in the third week of April. Finally, there were decreases in the means total numbers of the onion thrips, *T. tabaci* individuals in the last weeks of April, in the two successive onion seasons 2018 and 2019.

2- For the unreleased control areas, the mean total numbers of the onion thrips, *T. tabaci* individuals per season were; 26.6±2.9 (18.8-41.2) and 27.9±3.4 (18.2-42.3), for 2018 and 2019 seasons, respectively. While, the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 27.3(18.2-42.3) individuals. Statistical analysis by making a comparison between the two seasons 2018 & 2019, in case the mean total numbers of the onion thrips, *T. tabaci* individuals indicated that a very highly significant was obtained.

3- For the released areas of the ladybird coccinellid predator, *C. undecimpunctata*, the mean total numbers of the onion thrips, individuals per season were; 8.5±2.7(0.5-20.3) and 8.4±2.6(0.4-19.3), for 2018 and 2019 seasons, respectively. While, the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 8.5 (0.4-20.3). The mean percentage of the reduction of the onion thrips, *T. tabaci* individuals in areas that the ladybird predatory adults of the ladybird beetle *C. undecimpunctata* were released in comparison with that of the unreleased control areas was 69.90% in season 2018 and 68.40% in season 2019. The mean percentage of the reduction of the onion thrips, *T. tabaci* individuals for the two seasons together was 68.80% (69.90-68.40%). I.e., the percentage of reduction was relatively higher in the first season (2019) in compared with the second one (2019). Statistical analysis of the obtained data by making a comparison between the two seasons 2018 & 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the released area of the ladybird beetle, *C. undecimpunctata* indicated that a very highly significant was obtained. A comparison of the season 2018, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased area and the released area of the ladybird beetle, *C. undecimpunctata* showed that, no significant difference was obtained. A comparison of the season 2019, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased area and the released area by the ladybird beetle, *C. undecimpunctata* showed that no significant difference was obtained.

4- For the predatory lacewing larvae, C. *carnea*, the mean total numbers of the onion thrips, *T. tabaci* individuals per season were; 8.0±2.5 (2.5-19.5) and 7.9±2.6 (2.5-19.3), for 2018 and 2019 seasons, respectively. While, the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 8.0(2.5-19.5) individuals. The mean percentage of the reduction of the onion thrips, *T. tabaci* individuals in the released area of the green lacewing, *C. carnea* in comparison to that of the unreleased control was 69.9% in season 2018. While, in the season 2019, this percentage of the reduction in comparison to unreleased control was 71.7%. The mean percentage of the reduction in the mean total number of the onion thrips, *T. tabaci* individuals for the two seasons together was 70.6% (69.9-71.7%). Statistical analysis: indicated that a comparison between the two seasons 2018 & 2019, in

case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the released area of the green lacewing larvae, *C. carnea* showed that, a very highly significant was obtained. A comparison of the season 2018, in case of the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased area and the released area of the green lacewing larvae, *C. carnea* demonstrated that, a significant was obtained. A comparison of the season 2019, in case the mean total numbers of the onion thrips, *T. tabaci* individuals by comparing the unreleased control area and the released area of the green lacewing larvae, *C. carnea* showed that, a moderate significant was obtained.

5- Obtained results indicated the important role of releasing the two predators; the adults of the ladybird beetle, *C. undecimpunctata*, and the larvae of the green lacewing, *C. carnea*, as biocontrol agents against the onion thrips, *T. tabaci* on onion plants and/or other related plants that suffer from pest attack. Using such biocontrol agents must be included in I.P.M. strategies, for substituting the chemical control methods to avoid the hazards of the application of the direct insecticides. For example, many attempts were made to use the green lacewing, *C. carnea* in the field of biological control (Nordlund & Marrison, 1992), however, the green lacewing, *C. carnea* is taken as representative of chrysopidae to be use in biological control programs. This predator is characterized by it's expanded geographically distribution, the high compatibility to the different systems, the high searching ability (Azema & Mirabzadae, 2004), being a good candidate in I.P.M. programs as it is a voracious feeder (Balasubramani & Swamiappan, 1994). Moreover, it displays a relative broad range of the acceptable preys (Hydron & Whitecomb, 1979), having a degree of the easy to be mass produced in the laboratory (El-Arnaouty, 1991) and its tolerant to some groups of the pesticides (Azema & Mirabzadae, 2004).

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ARABIC SUMMARY

دراسة تأثير إطلاق المفترسين الشائعين: *Coccinella undecimpunctata* L. و *Chrysoperla carnea* Steph.، على كثافة التعداد لتربس البصل the onion thrips, *Thrips tabaci* (L.) ، المهاجم لنباتات البصل في الصوب المتواجدة في محافظة سوهاج.

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يعتبر محصول البصل (*Allium cepa* L.) في مصر من أهم المحاصيل الحقلية التي تزرع فيها باستمرار، وأيضا تتم زراعته على نطاق واسع في جميع أنحاء العالم. حيث يمكن زراعته في العديد من الظروف المناخية، ولكن تفضل تلك الزراعة في المناخ المعتدل الذي يتميز بقلة هطول الأمطار الغزيرة وعدم التواجد لدرجات الحرارة الشديدة. ويتعرض محصول البصل للإصابة بالعديد من الآفات الثاقبة الماصة مثل تربس البصل the onion thrips, *Thrips tabaci* (L.) (Thysanoptera: Thripidae) ، والذي يسبب ضررا واضحا للمحصول الناتج.

ولذا ، فقد أجريت هذه الدراسة لتقييم وتقدير التأثير الحادث بواسطة إطلاق المفترسين الشائعين : الحشرات الكاملة لمفترس أبى العيد 11 نقطة *Coccinella undecimpunctata* L. (Coloeptera : Coccinellidae) وكذلك إطلاق يرقات مفترس أسد المن *Chrysoperla carnea* Steph. (Neuroptera : Chrysopidae) لمكافحة تربس البصل the onion thrips, *T. tabaci* ، حيث تم عمل هذه الدراسة خلال الموسمين المتتاليين للبصل 2018 ، 2019 في منطقة الصوب الزراعية بمحافظة سوهاج ، مصر.

أظهرت النتائج المتحصل عليها، في حالة الكنترول (unreleased control- بدون إطلاق المفترسات) أن متوسط التعداد الكلى لأفراد تربس البصل the onion thrips, *T. tabaci* ، للموسم كان 26.6±2.9 (18.8-41.2) و 27.9±3.4 (18.2-42.3) فردًا ، للموسمين المتتاليين 2018 و 2019 ، على التوالي. بينما تبين أيضا ، في حالة إطلاق الحشرات الكاملة لمفترس أبى العيد 11 نقطة *C. undecimpunctata* في أقفاص داخل الصوب ، أن متوسط التعداد الكلى لأفراد تربس البصل the onion thrips, *T. tabaci* للموسمين معًا كان 27.3 (18.2-42.3) فردًا ، بمتوسط نسبة مئوية لخفض تعداد التربس the onion thrips, *T. tabaci* للموسمين معًا بلغت 68.80٪ (69.90 -68.40٪).

وسجل من النتائج المتحصل عليها ، أن متوسط التعداد الكلى المسجل لأفراد تربس البصل the onion thrips, *T. tabaci*، في حالة إطلاق يرقات مفترس أسد المن *C. carnea* كان 8.0 (2.5-19.5) فردًا ، للموسمين المتتاليين معا 2018 و 2019 ، بمتوسط نسبة مئوية لخفض تعداد التربس the onion thrips, *T. tabaci* للموسمين معًا بلغت 70.6٪ (69.9 -71.7٪).

وبالتالي، أشارت النتائج التي تم الحصول عليها إلى مدى أهمية الدور المهم لإطلاق للمفترسين: *C. undecimpunctata* و *C. carnea* ، كعوامل فعالة للمكافحة الحيوية ضد تربس البصل the onion thrips, *T. tabaci*. حيث يمكن إطلاقهما على نباتات البصل أو النباتات الأخرى ذات الصلة التي تتعرض للإصابة بتلك الآفة. ويجب أن يكون هذا الاستخدام في إطار منظومة المكافحة المتكاملة للآفات Integrated Pest Management (I.P.M.) ، لتقليل استخدام طرق المكافحة الكيميائية، وبالتالي تجنب مخاطر تطبيق المبيدات الحشرية المباشرة أو الغير مباشرة على تلوث البيئة.