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Ecological Studies on the Biological Integration Occurred by the Two Predators; 
Coccinella undecimpunctata L. and Hippodamia convergens Guer.
(Coleoptera: Coccinellidae), Following the Primary Parasitism Process of the Aphids on the Wheat Plants in Qalubia Governorate.

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ABSTRACT

Many aphids’ species are considered as the most serious insects’ pests that attack the wheat plants in Egypt, from planting date up to the harvesting time of the crop. Therefore, the present field study was carried out to estimate the population density of the wheat aphids’ species, the related parasitoids (either the primary or the secondary ones) and also the common predators of family Coccinellidae, which occurred on the wheat plants, during the two successive seasons 2017/2018 and 2018/2019, in Qalubia Governorate. The natural positive and negative relationships that were existed between the wheat aphids’ species and these common natural enemies were also studied. However, it is necessary for effective successful biological control programs to study the natural enemies’ activity, to evaluate the impact degree on the pests’ populations, and also to detect the need for any additional control measures to be applied. So, the obtained results revealed that the occurrence periods of the aphids’ species on the wheat plants were extended during the whole period of the wheat plantation (i.e., from the period extended from December to April), of the two studied seasons, 2017/2018 and 2018/2019. The total numbers of the wingless individuals were higher than those of the winged adults on the wheat plants. In addition, the total number of the aphids’ population in the second season (2018/2019) was higher as compared with that recorded in the first one (2017/2018) of the study. The aphids’ parasitoids immediately appeared in the wheat fields after the beginning of the aphids’ infestation, where the percentages of the aphids’ species parasitism were relatively lower in the two growing studied seasons. The primary parasitoid Aphidius colemani Viereck was the predominant parasitoid species recorded attacking the aphids’ species in the wheat fields, in comparison with the other recorded primary parasitoids. Where, the recorded primary parasitoids (Hymenoptera: Aphidiidae) were arranged according to the mean percentages of their occurrence to each others for the two seasons of the study as follows: A. colemani (52.03% (0.00-56.66%)) > Ephedus sp. (mostly E. persicae Froggatt) (33.04% (0.00-54.55%)) > Lysiphlebus sp. (10.41% (0.00-18.18%)) > Diaeretiella rapae Mcintosh (3.62% (0.00-14.28%)). As for the secondary parasitoids’ species, their total numbers were higher in the first season (2017/2018) in comparing with the second one (2018/2019) and they were also higher in their total numbers than those of the primary one, in the two investigated seasons. The mean percentages of the occurrence of the secondary parasitoids (the hyperparasitoids) species to each other for the two seasons of the study were; Dendrocerus spp. (Megaspidinae) (65.60%) > pteromalids spp. (Pteromalidae) (34.40%) and the period of their occurrence extended from January to April, in 2017/2018 and 2018/2019 seasons. Moreover, the obtained results revealed that the mean total numbers of adults of the two common recorded predatory’ species of family Coccinellidae, of the two seasons, were; Coccinella undecimpunctata L. (162.50 (0-103 adults)) > Hippodamia convergens Geur. (98.00 (0-87 adults)). The period of predatory’ species occurrence extended from January to April, in the two seasons (i.e., the period of the occurrence the covered the four months of the wheat plantation). As a result, the natural sequence role of the two biocontrol agents; the primary parasitoids’ species and the two major ladybirds’ predators (C. undecimpunctata and H. convergens), must be continuously encouraged and developed in the wheat fields by maintaining the suitable safe conditions to do such important natural role. Also, in the view of the natural occurrence of the previous biocontrol agents, they can be massed reared in the laboratory and released for controlling the aphids’ species on the wheat plants or the other related plants that are subjected to the aphids’ attack. They can be applied side by side with the other available safe control methods, in the frame of Integrated Pest Management (I.P.M.) programs, for protecting man heath and the surrounding environment from pollution.

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INTRODUCTION

The grass family (Gramineae) is considered as one of the largest plants’ families that contain the economic cereal plants including wheat, barley, corn, sorghum, oat, and ray (El-Heneidy & Adly, 2012). Wheat (*Triticum aestivum* L.) is considered as one of the most important of these growing cereal crops in the world (Adelaal *et al.*, 2014). It is widely cultivated all over the Egyptian Governorates (Tohamey & El-Sharkawy, 2014), representing the main winter cereal crop which gained particular importance for human consumption, as well as in animals and poultry feeding. The increases in its crop production and the available areas did not completely face the increasing demand for the increase in the human population, although, wheat production per unit area has significantly increased during the past decades. As a result, extensive local efforts are continuously developed to improve its production to reduce the existence of the “food gap” that is presented between the consumption and the production (El-Heneidy *et al.*, 2004a).

Wheatfields are attacked by several cosmopolitan aphids’ species (Homoptera: Aphididae), that are classified as important destructive pests (Reising *et al.*, 2012). Damages to the wheat plants caused by the aphids’ species were estimated by up to 23%, particularly in Upper Egypt, where the highest infestation level mostly occurs (Tantawi, 1985). Their damage to the plants is roughly happen through; the loss of the plant sap by the aphids sucking (Arif *et al.*, 2006), the reaction of the wheat plant tissues that are stimulated by the aphid’s saliva and the excretion of the viscous honeydew on them. Sooty-molds usually develop which ultimately hinders the photosynthesis process of the attacked wheat plants. Generally, aphids can infest leaves, stems, fruits and roots (Al-Antary & Abdel-Wali, 2015) and they can serve as vectors that are responsible for the transmission of many viral diseases to the wheat plants (Chapin *et al.*, 2001 and Saleh *et al.*, 2006). Aphids can reproduce with highly destructive populations in a fast short time (Gildow, 1993), where they are able to directly build up parthenogenetically (Dixon, 1998). For a long time, the insect pest control including aphids methods in many countries in the world (including Egypt), were dominated by the use of the synthetic chemical insecticides (Moussa *et al.*, 2014). Although, these insecticides are shown to have a highly effective and a rapid action, their extensive uses had resulted in many harmful environmental effects; such as their effects on human and also on the beneficial natural enemies (by the degradation of the natural equilibrium that existed between these natural enemies and their pests). This critical situation has been led to many considerable changes in the researches' attitudes towards the work on decreasing the extensive use of the harmful pesticides in agriculture. They directed their efforts towards the use of many safe alternatives, such as the building of Integrated Pest Management (I.P.M.) strategies against the agriculture pests (El-Khawas *et al.*, 2003).

The effective biological control applications often require a good understanding of the biology of the pests and their natural enemies, as well as the ability to identify the various life stages of relevant insects in the field. Field records of these natural enemies usually are necessary to monitor the natural enemies’ activity, evaluate the impact on the pest populations, and anticipate the need for using any additional control measures. Surely, the biological control methods were found to be an important safety component of I.P.M. programs, which offer one of the most alternative techniques and have an acceptable choice to decrease the use of the harmful chemicals (Abul-Fadl *et al.*, 2005). The principal advantages of these methods are the suppression of the insects’ pests below the economic injury levels, the self-production characteristics, and also the occurrence of the reduction effects on the surrounding environment and also the decrease of the health risks (Ehlers, 1990). However, Hafez (1994) showed that the ecological information on the interaction that occurred between the aphids’ species infesting wheat plants and their natural enemies seems to be very essential.
for developing I.P.M. programs in the wheat fields under the Egyptian conditions. While, Ibrahim and Megahed (2017) demonstrated that, the effective I.P.M. program always needs more and more of the recently developed information about the pest’s biology, ecology and the host range (i.e., the economic and the alternative plant hosts) to employ this information in forecasting the program and to took the direct decision of the cotton aphid *Aphis gossypii* Glov. control measures at a suitable time.

The impact of the tritrophic interaction occurred between the plants, the aphids’ species, and their natural enemies could be; either negative or positive, have cumulative effects on the reduction of the aphid populations (Messina & Soureson, 2001). As aphids are the subject key to the parasitism and the predation by different numbers of groups of relatively specific natural enemies, biological control is considered as an important component I.P.M. of the wheat aphids (Mohamed *et al.*, 2000). So, the objective of the present work was conducted in a wheat field located in Sariaqous district (Qalubia Governorate), during the two successive growing winter wheat seasons 2017/2018 and 2018/2019. This study can provide a baseline for many of the ecological information necessary for known the different relationships existed between aphids’ species and their common natural enemies (coccinellids’ predators & predators) and also to select the most suitable one to be used in the future when planning I.P.M. strategies against the aphids’ species attacking the wheat plants. The following points were concerned in this study involving:

1. Studying the population dynamics of the cereal aphids’ species attacking the wheat plants.
2. Studying the positive and the negative natural interactions occurred between the aphids’ species and their common recorded natural enemies (the parasitoids & the coccinellids’ predators) on the wheat plants including:
   A- The positive natural interaction occurred between the common recorded primary aphids’ parasitoids and the aphids’ species on the wheat plants.
   B- The positive natural interactions occurred between the common recorded coccinellids ladybird beetles and the aphids’ species on the wheat plants.
   C- The positive natural interactions occurred between the primary aphids’ parasitoids to each others and also the commonly recorded coccinellids predators to each others, on the wheat plants.
   C- The negative natural interaction occurred between the common recorded secondary aphids’ parasitoids (the hyperparasitoids) and the aphids’ species on the wheat plants.
3. The effect of the weather factors (the means of the temperatures and the relative humidity), on the populations of the aphids’ species and their common recorded natural enemies (the parasitoids either primary or secondary & the coccinellids’ predators).

### MATERIALS AND METHODS

Field studies were carried out in Sariaqous district (Qalubia Governorate), during the two successive growing winter wheat (variety Beni-Siwaf-5) seasons 2017/2018 and 2018/2019. An experimental area of one feddan cultivated in the third weeks of November, 2017 & 2018, respectively, was annually chosen for the sampling purpose. Where the investigated area received all the recommended agricultural practices throughout the whole growing seasons, expect the chemical insecticides which were entirely avoided (i.e., the studies were practiced under the free insecticidal applications).

Sampling was done in the morning on both surfaces of the wheat plant leaves and began at the second week of December (mostly during the early tillering stage of the wheat plants) and continued till the second week of April (at the full maturity of the cereals at the beginning of the wheat harvest time). Random regular weekly samples of 250 wheat plants
were carefully examined (throughout the different growth stages), where the total numbers of the cereal aphids' species were recorded and counted. At the same time, the common coccinellids’ predators that were observed in the investigated wheat field were directly recorded and counted throughout the two successive growing winter wheat seasons, 2017/2018 and 2018/2019. The percentages of occurrence of the winged adults and the wingless individuals of the aphids' species were calculated and the mean total numbers of the winged and the wingless individuals/one wheat plant were also estimated. The infested samples of the wheat plants with the aphids' species were weekly picked up, placed in paper bags, and transferred to the laboratory for further examination, where, the total numbers of the aphids’ mummies were directly counted. These samples were put in the laboratory for three days in labeled transparent plastic jars (22×9×13cm.) that were covered with muslin (under the laboratory conditions of 25±2ºC and 60±5%, for counting any formation of the newly aphids’ mummies, to calculate the total percentages of aphids' species parasitism. Then, these mummies were isolated and left until the emergence of the adults of the aphids' parasitoids either the primary or the secondary ones (the hyperparasitoids) from these parasitoids' mummies. The emerged adults of the parasitoids’ species were separately daily collected, transferred with a fine brush and preserved in small vials containing 70% alcohol, mounted on glass slides using Hoyers' medium for their identification by the aid of a binocular. They were classified and counted for each parasitoid species either the primary or the secondary one (the hyperparasitoid), to calculate the total percentages parasitism for both parasitoids’ species and also to evaluate the percentages of the occurrence of each parasitoid species separately to each others. Identification of the parasitoids species was made in the Biological Control Research Department, Agricultural Research Center (A.R.C.); however, the following equations were used in this study:

1- The percentages of the occurrence of either the winged adults or the wingless individuals of the recorded aphids' species were calculated according to the following equation:-

\[
\text{A or B} \times 100 \\
\text{C}
\]

Where: 
A = the total numbers of winged aphids adults that were directly counted in the field.
B = the total numbers of wingless aphids individuals that were directly counted in the field.
C = the total numbers of aphids’ individuals (winged & wingless ones) that were directly counted in the field.

2- The percentages of all of the aphids' species parasitism were calculated according to the following equation:-

\[
\frac{D+E}{C} \times 100
\]

Where:
D = the total numbers of the aphids’ mummies that were directly counted in the field samples.
E = the total numbers of the aphids’ mummies that were formed after putting the infested samples in the laboratory.
C = the total numbers of the aphids’ individuals (winged & wingless ones) that were directly counted in the field + D + E.

3- The percentages of the emergence of all of the recorded parasitoids from the whole recorded aphids' species mummies were calculated according to the following equation:-

\[
\frac{F}{G} \times 100
\]

Where:
F = the total numbers of all of the emerged adults’ parasitoids (the primary or the secondary ones) of the aphids species.
G = the total numbers of the whole recorded aphids' species mummies.
4- The percentages of the emergence of either the primary or the secondary parasitoids (the hyperparasitoids) from the aphids' species mummies were calculated according to the following equation:

\[
\text{Percentage of emergence} = \frac{H \text{ or } I}{G} \times 100
\]

Where: 
- \(H\) = the total numbers of the emerged primary parasitoids (the hyperparasitoids).
- \(I\) = the total numbers of the emerged secondary parasitoids (the hyperparasitoids).
- \(G\) = the total numbers of the whole recorded aphids' species mummies.

5- The percentages of occurrence of either the primary or the secondary parasitoids (the hyperparasitoids) of the aphids' species were calculated according to the following equation:

\[
\text{Percentage of occurrence} = \frac{J \text{ or } K}{L} \times 100
\]

Where: 
- \(J\) = the total numbers of the emerged primary parasitoids.
- \(K\) = the total numbers of the emerged secondary parasitoids (the hyperparasitoids).
- \(L\) = the total numbers of all of the emerged aphids' parasitoids (the primary & the secondary ones).

The obtained data were weekly recorded, arranged in monthly Tables, and statistically analyzed by using the variance-test (ANOVA), where the Least Significant Differences (L.S.D.) test was run to compare the means values at 5% level of probability using SPSS computerized program version (14.0). However, the correlations that were existed between; the aphids’ species, the total numbers of all parasitoids, the total numbers of the primary & the secondary parasitoids and the total numbers of the coccinellids’ beetles and the means of the temperatures (C˚) and the relative humidity (R.H. %), were also recorded, which were obtained from the Meteorological Station of the Agricultural Research Center (A.R.C.).

**RESULTS AND DISCUSSION**

**The Population Density of the Wheat Aphids' Species.**

The wheat aphids species (Homoptera: Aphididae) that were recorded attacking the wheat plants were mostly three aphids' species; *Rhopalosiphum padi* L., *R. maidis* Fitch, and *Schizaphis graminum* Rondani. As shown in Table (1) and Figs (1&5), the wheat aphids started to appear with monthly low total numbers (28&10 individuals), during December, 2017 & 2018 in 2017/2018 & 2018/2019 seasons, respectively. Then, they reached the maximum total numbers (3506 & 3891 individuals) during February, 2018 and March, 2019, respectively. Finally, their monthly total numbers decreased to reach low monthly total numbers of 204&349 individuals during April, 2018 & 2019, respectively. The occurrence periods of the aphids’ species were extended from the periods extended from December to April, in the two successive seasons, 2017/2018 and 2018/2019. The mean total numbers of the aphids' individuals (winged adults & wingless individuals) per season were; 1397.80±627.37 (28-506) & 1404.80±7.00 (10-506) individuals, respectively, while the mean total number for the two seasons was 1404.80±7.00 (10-506).

The winged adults of the wheat aphids had the highest monthly total numbers (125&297 winged adults) during February, 2018 & March, 2019, with the percentages of their occurrence of 3.57&7.63%, respectively. The mean total numbers of winged adults per season were; 60.60±26.64 (3-125) & 82.40±54.88 (5-297) adults, respectively, while the mean total number for the two seasons together was 71.50±10.90 (3-297) adults. The mean total numbers of winged adults per one wheat plant were 0.06±0.03 (0.00-0.13) & 0.09±0.05 (0.01-0.30), while the mean total number for the two seasons was 0.08±0.02 (0.00-0.13) winged adults.
The wingless individuals of the wheat aphids had the highest monthly total numbers (3381 & 3594 wingless individuals) during February, 2018 & March, 2019, with the percentages of their occurrence of 96.43 & 92.37%, respectively. The mean total numbers of wingless individuals per season were; 1337.20±604.87 (23-3381) & 1329.40±723.33 (7-3594) individuals, respectively, while the mean total number for the two seasons was 1333.25±3.90 (7-3594) wingless individuals. The mean total numbers of wingless individuals per one wheat plant were; 1.41±0.55 (0.09-3.38) & 1.39±0.70 (0.03-3.59), for the two studied seasons 2017/2018 and 2018/2019, respectively, while the mean total number for the two seasons was 1.40±0.01 (0.03-3.59) wingless individuals. The following were recorded from the present study:

1. The obtained data revealed that the total numbers of wingless individuals were higher in their numbers than those of winged adults on the wheat plants.

2. The total numbers of the aphids’ population in the second season (2018/2019) were relatively higher as compared with that recorded in the first one (2017/2018).

Statistical analysis of the obtained data (Table, 1) revealed that the comparisons between the two studied seasons 2017/2018 and 2018/2019 were recorded as follows:-

- No significant difference was obtained in case of comparing the total no. of the aphids’ species (value = 0.235 & correlation=0.650).

- A very highly significant difference was obtained in the case of the total numbers of the winged aphids’ species (value = 0.911 & correlation=0.070).

- No significant difference was obtained in case of comparing the total numbers of the wingless aphids’ individuals (value = 0.206 & correlation=0.681).

- No significant difference was obtained in case of comparing the total numbers of the aphids’ mummies (value = 0.041 & correlation=0.894).

Table 1: The monthly total numbers of the aphids’ individuals (the winged & the wingless individuals), their percentages of occurrence and also the total numbers of the aphids mummies, that were recorded on the wheat plants, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

| Months       | Total no. of all aphids’ species | Winged aphids’ adults | Wingless aphids’ individuals | Weather factors |
|--------------|---------------------------------|-----------------------|------------------------------|-----------------|
|              | Total no. | Mean total no. per one plant | Mean total % | Total no. | Mean total no. per one plant | Mean total % | Mean C* | Mean R.H. % |
| December, 2017 | 28        | 5.00                      | 17.86          | 23       | 0.09                        | 81.14         | 17.50 | 57.35       |
| January, 2018  | 1520      | 120                      | 7.89           | 1400     | 1.12                        | 92.11         | 15.48 | 55.63       |
| February       | 3506      | 125                      | 3.57           | 3381     | 3.38                        | 96.43         | 20.75 | 51.90       |
| March          | 1731      | 50                       | 2.89           | 1681     | 1.68                        | 97.11         | 22.10 | 43.78       |
| April          | 204       | 3.01                      | 1.47           | 201      | 0.80                        | 98.53         | 23.50 | 44.39       |
| Mean/season    | 1397.80   | ± 627.37                 | ± 26.64        | 4.06     | ± 0.03                      | (1.47-%17.86%)| 1337.20 | ± 604.87 | ± 0.55 | (1.47-%17.86%) | 95.60% | (81.14-%97.11%) | 19.87%* | 50.43% |
| Mean/season    | 2018/2019 | 7.00                      | 7.00           | 7.00     | 7.00                        | 70.00         | 15.48 | 43.78       |
| December, 2018 | 10        | 3.01                      | 3.00           | 7        | 0.03                        | 70.00         | 15.48 | 43.78       |
| January, 2019  | 243       | 27                      | 11.11          | 216      | 0.17                        | 88.89         | 14.03 | 42.40       |
| February       | 2566      | 71                      | 2.77           | 2495     | 2.50                        | 97.23         | 14.71 | 49.71       |
| March          | 3891      | 297                      | 7.63           | 3594     | 3.59                        | 92.37         | 17.74 | 51.68       |
| April          | 349       | 14                      | 4.01           | 335      | 0.67                        | 95.99         | 20.23 | 45.33       |
| Mean/season    | 1411.50   | ± 772.63                 | ± 54.88        | 5.84%    | (2.77-%30.00%)              | 1329.40       | 1.59  | 94.16%       |
| Mean/season    | 2018/2019 | (10-891)                 | (5-297)        | 1.59     | (10-891)                    | (5-297)       | 1.59  | 94.16%       |
| Mean/season    | 1404.80   | ± 772.63                 | ± 54.88        | 5.84%    | (2.77-%30.00%)              | 1329.40       | 1.59  | 94.16%       |
| Mean/season    | (10-506)  | (3-297)                  | (0.00-0.13)    | 5.84%    | (2.77-%30.00%)              | 1329.40       | 1.59  | 94.16%       |

Table 1:

| Statistical analysis |
|----------------------|
| The comparisons between the two studied seasons 2017/2018 and 2018/2019 were recorded as follows:-|
| - No significant difference was obtained in case of comparing the total no. of the aphids’ species (value = 0.235 & correlation=0.650).|
| - A very highly significant difference (****) was obtained in case of the total no. of the winged aphids’ species (value = 0.911 & correlation=0.070).|
| - No significant difference was obtained in case of comparing the total numbers of the wingless aphids’ individuals (value = 0.206 & correlation=0.681).|
| - No significant difference was obtained in case of comparing the total no. of the aphids’ mummies (value = 0.041 & correlation=0.894).|

Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900
The infestation by the recorded aphids' species to the wheat plants were shown by many authors such as; Abdel-Rahman et al. (2000) and El-Heneidy et al. (2007). It was demonstrated that the highest rates of the infestation by the aphids' species in the wheat fields were recoded; during March (El-Heneidy & Attia, 1988/1989 and Vandereycken et al., 2015), during March & April (Hafez, 1994) and during February & March (El-Heneidy et al., 2004a). Moreover, Ali and Darwish (1990) indicated that the population density of aphids reached 10% of the maximum population density in mid. March. Also, Ali et al. (1991) revealed that the total numbers of *S. graminum* and *R. padi* peaked in late February and in the first half of March during the two respective studied seasons. However, El-Heneidy (1994) showed that, in Egypt, the active period of the cereal aphids in the wheat fields usually start from the late tillering growth (mostly during January) and continued through the wheat stem elongation, booting, heading, and ends during the ripening stage (mostly during April). While, Milne and Delevs (1999) stated that, the maximum percentages of the infestation of the wheat stems by the aphids’ species were ranged from 14-34%. But, Ahmed et al. (2016) revealed that the aphid infestation on the wheat plants started from the fourth week of January to the third week of March, increased until finally decreased during the second week of April.

The Natural Relationships (the Positive and Negative Ones) that Existed Between the Natural Enemies and the Wheat Aphids’ Species.

The Parasitism of the Wheat Aphids’ Species.

As shown in Table (2) and Fig. (2), the occurrence periods of the aphids’ mummies were extended from; (December, 2017 to April, 2018) and (from January, 2019 to April, 2019), in the two successive seasons 2017/2018 and 2018/2019, respectively. The highest total numbers of the aphids’ mummies (653&740 mummies) were recorded during March, 2018 & March, 2019, respectively. The mean total numbers of the aphids’ mummies per season were; 278.60±134.15 (4-653) & 219.20±29.70 (0-740), respectively, while the mean total number of the aphids’ mummies of the two seasons was 248.90±29.70 (0-740) mummies. The highest monthly mean percentages of the aphids’ parasitism (37.72&19.02%) were recorded during March, 2018 and March, 2019, respectively. The mean percentages of the aphids’ parasitism per season were; 19.93% (9.67-37.72%) & 15.53% (0.00- 27.98%), respectively, with a mean total percentage of the aphids’ parasitism of the two seasons of 17.73% (0.00-37.72%). The highest total numbers of the all emerged aphids’ parasitoids species (163&103 parasitoids) were recorded during March, 2018 and March, 2019, respectively. The mean total numbers of the aphids’ parasitoids per season were; 76.40±31.67 (0-163) &43.60±19.04 (0-103) parasitoids, respectively, while the mean total number of the emerged aphids’ parasitoids of the two seasons was 60.00±16.40 (0-163) parasitoids. The highest monthly mean percentages of the aphids’ parasitoids emergence (54.42&55.88%) were recorded during January, 2018 & January, 2019, respectively. The mean percentages of the aphids’ parasitoids emergence per season were; 27.42% (0.00-54.42%) &19.89% (0.00- 55.88%), respectively, with a mean percentage of the aphids’ parasitoids emergence of the two seasons of 23.74% (0.00-55.88%). The highest monthly mean percentages of the primary aphids’ parasitoids occurrence (92.50& 97.37%) were recorded during January, 2018 & January, 2019, respectively. The mean percentages of the primary aphids’ parasitoids occurrence per season were; 36.91% (0.00-92.50%) & 36.70% (0.00-97.37%), respectively, while the mean percentage of the primary aphids’ parasitoids occurrence of the two seasons of 36.81% (0.00-97.37%). The highest monthly mean percentages of the secondary aphids’ parasitoids occurrence (100.00&89.32%) were recorded during April, 2018 & March, 2019, respectively. The mean percentages of the secondary aphids’ parasitoids occurrence per season were; 63.09% (0.00-100.00%) & 63.30% (0.00-89.32%), while the mean percentage of the secondary aphids’ parasitoids occurrence of the two seasons was 68.33% (0.00-100.00%). The seasonal ratio between the (primary: secondary parasitoids) per season were; 1:1.71 &
For the two studied seasons 2017/2018 & 2018/2019, respectively, while the general ratio for the two seasons was 1:1.73. Therefore, obtained results revealed that the aphids’ parasitoids were immediately present in the wheat field after the aphid infestation. Moreover, the secondary aphids’ parasitoids (the hyperparasitoids) were higher than those of the primary one in the case of the two seasons separately and also in case of the general ratio between them of the two studied seasons.

Statistical analysis of the obtained data (Table 2) revealed that there was no significant difference between the two studied seasons 2017/2018 and 2018/2019, in case of comparing the total numbers of the emerged aphids’ parasitoids species (value = 0.002&correlation=0.988). In general, El-Heneidy and Abdel-Samad (2001) showed that the highest monthly mean of percentages of aphids’ parasitism (8.96%) was obtained during April, while the lowest one (1.25%) was recorded during January. They found that the maximum percentage of the naturally occurring parasitism (36%) that had recorded on the cereal aphids, was in Upper Egypt. Similarly, El-Heneidy et al. (2004a) showed that the mummified aphid densities had a marked increase in their numbers at the start of the aphids’ population decline. The increase rate of the occurrence of the aphids’ parasitoids usually follows the increase in the aphids’ population, where the peak of the aphid parasitoids was recorded two weeks post the peak of the aphids’ individuals.

Table 2: The monthly percentages of the aphids’ species parasitism, the percentages of parasitoids emergence, the percentages of the emerged primary & secondary parasitoids and the ratios between these parasitoids that were recorded from the aphids’ species attacking the wheat plants, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

| Months       | Total no. of the aphids’ mummies | % Parasitism of all aphids’ species | Total no. of all emerged parasitoids’ species | % Emergence of all parasitoids’ species from aphids’ mummies | % Occurrence of the emerged parasitoids | Ratios (primary : secondary) parasitoids |
|--------------|----------------------------------|-----------------------------------|-----------------------------------------------|---------------------------------------------------------------|----------------------------------------|------------------------------------------|
| December, 2017 | 4                                | 14.29%                            | 0                                             | 0.00                                                          | 0.00                                   | -                                        |
| January, 2018  | 147                              | 9.67%                             | 80                                            | 54.42                                                         | 92.50                                  | 7.50                                     |
| February       | 546                              | 15.57%                            | 127                                           | 23.26                                                         | 47.24                                  | 52.76                                    |
| March          | 653                              | 37.72%                            | 163                                           | 24.96                                                         | 4.29                                   | 95.71                                    |
| April          | 43                               | 21.08%                            | 12                                            | 27.91                                                         | 0.00                                   | 100.00                                   |
| Mean/Season    | 278.60±134.15 (4-653)            | 19.93% (9.67-37.72)%              | 76.40±131.67 (0-163)                          | 27.42% (0.00-54.42)%                                         | 36.91% (0.00-92.50)%                   | 63.09% (0.00-100.00%)                    |
| 2018/2019      | 68                               | 27.98%                            | 38                                            | 55.88                                                         | 97.37                                  | 2.63                                     |
| January, 2019  | 259                              | 10.09%                            | 68                                            | 26.25                                                         | 44.12                                  | 55.88                                    |
| February       | 740                              | 19.02%                            | 103                                           | 13.92                                                         | 10.68                                  | 89.32                                    |
| March          | 29                               | 8.31%                             | 9                                             | 31.03                                                         | 22.22                                  | 77.78                                    |
| Mean/Season    | 219.20±137.82 (0-740)            | 15.53% (9.00-27.98)%              | 43.60±19.04 (0-103)                           | 19.59% (0.00-55.88)%                                         | 36.70% (0.00-97.37)%                   | 63.30% (0.00-89.32%)                    |
| 2018/2019      | 138.72±62.17 (0.740)            | 17.73% (9.00-37.72)%              | 60.00±16.40 (0-163)                           | 23.74% (0.00-55.88)%                                         | 36.81% (0.00-97.37)%                   | 66.33% (0.00-100.00%)                    |
| General ratio  | 1:1.76                           |                                   | 1:1.76                                        |                                                               |                                        | 1:1.76                                   |

As the aphids’ parasitoids are shown to be of important value in the bio-control of the aphids’ pests (Brewer & Elliott, 2004), the taxonomy, the distribution and the abundance of
them have been well investigated in many parts of the world (Tomanović et al., 2005). For example, Ahmed et al. (2016) mentioned that the parasitism of the cereal aphids infesting the wheat plants by a braconid species occurred in the third week of February and reached a peak in March. While, Youssif et al. (2017) cleared that, the aphids’ parasitism occurred during the period extended from the fourth week of January till the third week of April. The parasitism percentages fluctuated to recorded three peaks in the wheat fields, where, the first one was found in the third week of February. The second peak took place at the end of March, while the third and the highest one occurred in the third week of April. The obtained results indicated that the percentages of the aphids’ species parasitism in the wheat fields were lower in the two studied seasons 2017/2018 and 2018/2019. This result was in agreement with that recorded by El-Heneidy et al. (2004a) who found that the rates of aphids’ species parasitism in the wheat fields were lower in the growing studied seasons.

**The Positive Primary Parasitism that Recorded Associated with the Aphids’ Species in the Wheat Fields.**

As shown in Table (3) and Fig. (3), four primary parasitoids’ species namely: *Aphidius colemani* Viereck, *Diaeretiella rapae* McIntosh, *Ephedrus* sp. (mostly *E. persicæ* Froggatt) and *Lysiphlebus* sp. (Hymenoptera: Aphidiidae), were recorded during this study. The period of their occurrence extended from; (January to March, 2018) and (from January to April, 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the periods of the primary parasitoids’ species occurrence covered three and four months, respectively). The highest monthly total numbers of the primary parasitoids’ species (74&37 parasitoids) were during the two months of January, 2018 & 2019, respectively. The total numbers of the primary parasitoids’ species per season were; 141(0-74) & 80(0-37) parasitoids, respectively, while the mean total number of the primary parasitoids’ species of the two seasons was 110.50(0-74) parasitoids.

**The Occurrence of the Primary Parasitoid *A. colemani*:**

The periods of the occurrence of the primary parasitoid *A. colemani* extended from; (January to March, 2018) & (from January to April, 2019), in the two seasons 2017/2018 and 2018/2019, respectively, (i.e., the period of the parasitoid species occurrence covered three and four months during the two seasons, respectively). The highest monthly total numbers of the parasitoid species (36&24 parasitoids) were recorded during the two months of January, 2018 & 2019, respectively. The total numbers of the parasitoid *A. colemani* per season were; 73(0-36) & 42(0-24) parasitoids, respectively, while the mean total number of the parasitoid *A. colemanii* of the two seasons was 57.50(0-36) parasitoids. Similarly, this parasitoid species was recorded associated with aphids in the wheat fields by El-Heneidy et al. (2004b); Sobhy et al. (2004) and Selman (2006).

**The Occurrence of the Primary Parasitoid *D. rapae*:**

Very few total numbers of the primary parasitoid *D. rapae* were recorded during the two successive seasons of the study. The periods of the occurrence of the parasitoid *D. rapae* were only; (during January & March, 2018 in season 2017/2018) and (from January to March, 2019, in season 2018/2019). The highest monthly total numbers of the parasitoid species (2&3 parasitoids) were recorded during the two months of January, 2018 & 2019, respectively. The total numbers of the parasitoid *D. rapae* per season were; 3(0-2) & 5(0-3) parasitoids, respectively, while the mean total number of the parasitoid *D. rapae* of the two seasons was 4.00(0-3) parasitoids. Similarly, this parasitoid species was recorded associated with aphids in the wheat fields by Abdel-Rahman, (2005) and El-Fatih (2006).
Table 3: The monthly total numbers of the primary parasitoids, their percentages of occurrence and the ratios between them and the aphids’ species attacking the wheat plants that were recorded, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

| Months | Total no. of the primary parasitoids | A. colemani | D. rapae | Ephedrus sp. (mostly E. persicae Froggatt) | Lysiphlebus sp. | Ratios (primary parasitoids: aphids) |
|--------|-------------------------------------|-------------|----------|------------------------------------------|----------------|-----------------------------------|
|         | Total no. | Mean total % | Total no. | Mean total % | Total no. | Mean total % | Total no. | Mean total % |                                |                                |
| December 2017 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0.28 |
| January 2018 | 74 | 36 | 48.65 | 2 | 2.70 | 24 | 32.43 | 12 | 16.22 | 1:20.54 |
| February | 60 | 34 | 56.68 | 0 | 0.00 | 22 | 36.67 | 4 | 6.67 | 1:55.43 |
| March | 7 | 3 | 42.86 | 1 | 14.28 | 3 | 42.86 | 0 | 0.00 | 1:247.29 |
| April | 0 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0.204 |
| Total/season | 141(0.74) | 73(0.35) | 51.77% (0.00-56.68%) | 3(0.2) | 1.23% (0.00-14.28%) | 49(0.24) | 34.75% (0.00-42.86%) | 16(0.12) | 11.35% (0.00-16.22%) | 1:49.57 |
| (Mean/month) | 28.20 | 14.80 | 51.77% (0.00-56.68%) | 0.60 | 1.23% (0.00-14.28%) | 9.80 | 34.75% (0.00-42.86%) | 3(0.2) | 11.35% (0.00-16.22%) | 1:49.57 |

2018/2019

| Total/season | 80(0.37) | 42(0.24) | 52.50% (0.00-50.00%) | 5(0.3) | 6.25% (0.00-9.09%) | 26(0.12) | 32.50% (0.00-54.35%) | 7(0.3) | 8.75% (0.00-16.11%) | 1:88.24 |
| (Mean/month) | 16.00 | 8.40 | 52.50% (0.00-50.00%) | 1.00 | 6.25% (0.00-9.09%) | 2.00 | 32.50% (0.00-54.35%) | 1.00 | 8.75% (0.00-16.11%) | 1:88.24 |
| Note: Significant (0.500-0.600) **Moderate significant (0.600-0.800) ***Highly significant (0.800-0.900) ****Very highly significant>0.900.

The Occurrence of the Primary Parasitoid Ephedrus sp.:

The periods of the occurrence of the primary parasitoid Ephedrus sp. extended from; (January to March, 2018) & (from January to April 2019), in the two seasons 2017/2018 and 2018/2019, respectively (i.e., the period of the parasitoid species occurrence covered three and four months during the two seasons, respectively). The highest monthly total numbers of the parasitoid species (24&12 parasitoids) were during January, 2018 & 2019. The total numbers of the parasitoid Ephedrus sp. per season were; 49(0-24) & 26(0-12) parasitoids, respectively, while the mean total number of the parasitoid Ephedrus sp. of the two seasons was 37.50(0-24) parasitoids. Similarly, this parasitoid species was recorded associated with aphids in the wheat fields by Sobhy et al. (2004) and El-Fatih (2006).

The Occurrence of the Primary Parasitoid Lysiphlebus sp.:

The periods of the occurrence of the primary parasitoid Lysiphlebus sp. were only recorded; (during the two months January & February, 2018 in season 2017/2018) and (from January to March, 2019 in season 2018/2019). The highest monthly total numbers of the parasitoid species (12&3 parasitoids) were during January, 2018 & 2019, respectively. The total numbers of the parasitoid Lysiphlebus sp. per season were; 16(0-12) & 7(0-3) parasitoids, respectively, while the mean total number of the parasitoid Lysiphlebus sp. of the two seasons was 11.50(0-12) parasitoids. Similarly, this parasitoid species was recorded associated with aphids in the wheat fields by Megahed (2000).

However, the recorded primary parasitoids could be arranged according to the mean percentages of their occurrence to each other for the two seasons of the study as follows: A. colemani (52.03%(0.00-56.66%)) > Ephedrus sp. (33.94%(0.00-54.55%)) > Lysiphlebus sp.
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(10.41%(0.00-18.18%) > D. rapae (3.62%(0.00-14.28%)), of the total percentages of all the primary parasitoids’ species occurrence. I.e., the primary parasitoid A. colemani was the predominant parasitoid species recorded attacking the aphids’ species in the wheat fields. This result is in agreement with that of El-Heneidy et al. (2004a) who surveyed the following parasitoid species attacking the wheat aphids: A. colemani, D. rapae, and Ephedrus sp., where the two parasitoids; D. rapae and A. colemani were among the most dominant primary parasitoids recovered from the cereal aphids. Also, the obtained results concerning the monthly ratios between the surveyed primary parasitoids’ species and the aphids’ species attacking the wheat plants were shown in Table (3). The most acceptable seasonal ratios between the surveyed primary parasitoids’ species and the aphids’ species attacking the wheat plants were; 1:20.54 & 1:5.57, which were recorded during the two months of January, 2018 & 2019, in 2017/2018 and 2018/2019 seasons, respectively. The seasonal ratios that were recorded between the surveyed primary parasitoids’ species and the aphids’ species attacking the wheat plants per season were; 1:49.57 & 1:88.24 in the case of seasons 2017/2018 and 2018/2019, respectively. The general ratio that was recorded between the surveyed primary parasitoids’ species and the aphids’ species attacking the wheat plants for the two seasons was 1:63.57.

Statistical analysis of the obtained data (Table, 3) revealed that the comparisons between the two studied seasons 2017/2018 and 2018/2019 were recorded as follows:-
- No significant difference was obtained in the case of comparing the total numbers of the primary parasitoids’ species (value = 0.002&correlation =0.985).
- No significant difference was obtained in the case of comparing the total numbers of the parasitoid A. colemani (value = 0.008&correlation=0.964).
- No significant difference was obtained in the case of comparing the total numbers of the parasitoid D. rapae (value = 0.030&correlation=0.913).
- No significant difference was obtained in case of comparing the total numbers of the parasitoid Ephedrus sp. (value = 0.085&correlation=0.826).
- No significant difference was obtained in the case of comparing the total numbers of the parasitoid Lysiphlebus sp. (value = 0.126&correlation =0.772).

The Negative Secondary Parasitism (the Hyperparasitism) Recorded Associated with the Primary Aphids’ Parasitoids Species in the Wheat Fields.

As shown in Table (4) and Fig. (3), the secondary parasitoids species; Dendrocerus spp. (Megaspidiidae) and pteromalids spp. (Pteromalidae), were the only recorded secondary parasitoids’ species (the hyperparasitoids) during this study. The periods of their occurrence extended from; (January to April, 2018) & (from January to April, 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the periods of the secondary parasitoids’ species occurrence covered four months, in case of the two studied seasons). The highest monthly total numbers of the secondary parasitoids’ species (156&92 parasitoids) were recorded during the two months of March, 2018, and 2019, respectively. The total numbers of the secondary parasitoids’ species per season were; 241(0-156) &138(0-93) parasitoids, respectively, with a mean total number of the secondary parasitoids’ species of the two seasons of 198.50(0-156) parasitoids.

The obtained results revealed that the total numbers of the secondary parasitoids’ species were higher in the first season (2017/2018) in comparing with the second one (2018/2019). Also, the obtained monthly ratios between the surveyed secondary parasitoids’ species and the aphids’ species attacking the wheat plants were shown in Table (4), where, the most acceptable seasonal ratios between the surveyed secondary parasitoids’ species and the aphids’ species attacking the wheat plants were; 1:11.10 & 1:42.29, that were recorded during the two months of March, 2018 & 2019, in 2017/2018 and 2018/2019 seasons, respectively. The seasonal ratios that were recorded between the surveyed secondary parasitoids’ species
and the aphids’ species attacking the wheat plants per season were; 1:29.00 & 1:51.16 in the case of seasons 2017/2018 and 2018/2019, respectively. The general ratio that was recorded between the surveyed secondary parasitoids’ species and the aphids’ species attacking the wheat plants for the two seasons was 1:37.07. However, the phenomenon of hyperparasitism is very common in the aphids’ parasitoids and the hyperparasitoids’ species were shown to be found in the wheat fields from the period extended from late February until the end of April (Abdel-Rahman, 2005). The highest percentages of parasitism were mostly estimated during the boating and the heading growth stages of the wheat plants (late February - mid. April) to coincide more or less with the highest population of the cereal aphids on the wheat plants (Selman, 2006). Two common theories were stated concerning the role of the hyperparasitoids; the first one was that the primary parasitoids attack only a small percentage of the wheat available aphids and this is because their numbers are regulated by the occurrence of the secondary ones (Christine et al., 1999). In this way, hyperparasitism has traditionally been viewed in the context of the applied ecology as being harmful and so it is believed to have usually a negative impact on the beneficial primary parasitoids. The second opposite theory was that there is a contrary speculation as to the hyperparasitoids’ play a possible positive role in maintaining a proper balance between the primary parasitoids and their hosts by preventing an excessive buildup of the parasitoids’ numbers (Van Den Bosch et al., 1979).

The Occurrence of the Secondary Parasitoids *Dendrocerus* spp.:
The periods of the secondary parasitoids *Dendrocerus* spp. occurrence extended from; (January to April, 2018) & (from January to April, 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the period of the secondary parasitoids *Dendrocerus* spp. covered four months of the two studied seasons). The highest monthly total numbers of the secondary parasitoids *Dendrocerus* spp. (101&55 parasitoids) were recorded during the two months of March, 2018 and 2019, respectively. The total numbers of the secondary parasitoids *Dendrocerus* spp. per season were; 166(0-101) & 86(0-56) parasitoids, respectively, with a mean total number of the secondary parasitoids *Dendrocerus* spp. of the two seasons of 126.50(0-101) parasitoids. In similar results, Abdel-Rahman (2005) and El-Fatih (2006) surveyed the secondary parasitoids *Dendrocerus* spp., as the hyperparasitoids’ species that were recovered from the primary ones (which parasitized the cereal aphids’ species in the wheat fields).

The Occurrence of the Secondary Parasitoids *Pteromalids* spp.:
The periods of the secondary parasitoids *Pteromalids* spp. occurrence extended from; (January to April, 2018) & (from January to April, 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the period of the secondary parasitoids *Pteromalids* spp. covered four months of the two studied seasons). The highest monthly total numbers of the secondary parasitoids *Pteromalids* spp. (55&37 parasitoids) were recorded during the two months of March, 2018 and 2019, respectively. The total numbers of the secondary parasitoids *Pteromalids* spp per season were; 75(0-55) & 52(0-37) parasitoids, respectively, with a mean total number of the secondary parasitoids *Pteromalids* spp. of the two seasons of 63.50(0-55) parasitoids. The obtained results were in agreement with those of Abdel-Rahman (2005) and El-Fatih (2006) who surveyed the secondary *Pteromalids* spp. parasitoids (*Asaphes* & *Pachyneuron*), as the hyperparasitoids’ species that were recovered from the primary ones (which parasitized the cereal aphids’ species in the wheat fields).

Statistical analysis of the obtained data (Table, 4) revealed that the comparisons between the two studied seasons 2017/2018 and 2018/2019 were recorded as follows:-
- No significant difference was obtained in case of comparing the total numbers of the secondary parasitoids species (value = 0.000&correlation=1.000).
- No significant difference was obtained in case of comparing the total numbers of *Dendrocerus* spp. parasitoids (value = 0.000& correlation=0.998).
No significant difference was obtained in case of comparing the total numbers of pteromalids spp. parasitoids (value = 0.000 & correlation = 0.998).

Table 4: The monthly total numbers of the secondary parasitoids, their percentages of occurrence and the ratios between them and the aphids' species attacking the wheat plants that were recorded, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate

| Months        | Total no. of the secondary parasitoids | Dendroxerus spp. (2 spp.) | Pteromalids (2 spp.) | Ratios (secondary parasitoids: aphids) |
|---------------|----------------------------------------|---------------------------|---------------------|----------------------------------------|
|               | Total no. | Mean total % | Total no. | Mean total % | 2017/2018 | 2018/2019 |
| December, 2017| 0         | 0.00         | 0         | 0.00         | 0.28      | 1:235.33  |
| January, 2018 | 6         | 66.67        | 2         | 33.33        | 1:52.33   | 1:235.33  |
| February      | 67        | 76.12        | 16        | 23.88        | 1:52.33   | 1:235.33  |
| March         | 156       | 64.74        | 55        | 35.26        | 1:11.10   | 1:235.33  |
| April         | 12        | 83.33        | 2         | 16.67        | 1:17.00   | 1:235.33  |
| Total/season  | 241       | 68.88%       | 75        | 31.12%       | 1:29.00   | 1:235.33  |
| (Mean/month)  | (48.20±29.49) | (0.00-83.33%) | (15.00±10.40) | (0.00-35.26%) | 1:29.00   | 1:235.33  |
| December, 2018| 0         | 0.00         | 0         | 0.00         | 0.10      | 1:235.00  |
| January, 2019 | 1         | 0.00         | 1         | 100.00       | 1:235.00  | 1:235.00  |
| February      | 38        | 65.79        | 13        | 34.21        | 1:67.33   | 1:235.00  |
| March         | 92        | 59.78        | 37        | 40.22        | 1:42.29   | 1:235.00  |
| April         | 7         | 85.71        | 1         | 14.29        | 1:49.88   | 1:235.00  |
| Total/season  | 138       | 62.32%       | 32        | 37.68%       | 1:31.16   | 1:235.00  |
| (Mean/month)  | (27.60±17.53) | (0.00-85.71%) | (10.40±7.07) | (0.00-100.00%) | 1:31.16   | 1:235.00  |
| Mean/seasons  | 195.50    | 65.00%       | 63.30     | 34.00%       | 1:37.97   | 1:235.00  |
| (Mean/month)  | (37.90±10.30) | (0.00-85.71%) | (12.70±2.30) | (0.00-100.00%) | 1:37.97   | 1:235.00  |

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

The Positive Relationship Occurred between the Coccinellids Predators and the Aphids' Species in the Wheat Fields.

As shown in Table (5) and Figs (4&5), the two predatory species; Coccinella undecimpunctata L. and Hippodamia convergens Geur. (Coccinellidae), were the only recorded predators having the highest occurrence during this study. The periods of their occurrence extended from; (January to April, 2018) & (from January to April, 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the periods of the coccinellids predatory species occurrence covered four months, in case of the two studied seasons). The highest monthly total numbers of the coccinellids predatory individuals (176&282 individuals) were recorded during the two months of April, 2018 and 2019, respectively. The total numbers of the coccinellids predatory individuals per season were; 492(0-176) & 505(0-282) individuals, respectively, with a mean total number of the coccinellids predatory individuals of the two seasons of 498.50(0-282) individuals. The obtained results revealed that the total numbers of the coccinellids predatory individuals were higher in the second season (2018/2019), in comparing with the first one (2017/2018). Obtained results are in accordance with the findings of Hafez (1994) who reported that the peak number of the
predators occurred during April, which was later than the highest infestation period of the cereal aphids in the wheat fields (that was recorded in March). But, El-Heneidy et al. (2004a) stated that the population density of the predators depended on the densities of aphids in the wheat fields and reached their maximum value during February and March, then decreased at the end of the season. In general, Kacar (2015) revealed that the coccinellids’ predators have been widely known as useful predators attacking aphids.

**The Occurrence of the Ladybird Predator *C. undecimpunctata***

The periods of the ladybird predator *C. undecimpunctata* occurrence extended from; (January to April, 2018 & 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the periods of the ladybird predator *C. undecimpunctata* covered four months of the two studied seasons). The highest monthly total numbers of the ladybird predator *C. undecimpunctata* (70&103 predators) were recorded during February, 2018 and April, 2019 in seasons 2017/2018 and 201/2019, respectively. The total numbers of the ladybird predator *C. undecimpunctata* per season were; 116(0-70) & 209(0-103) predators, respectively, with a mean total number of the ladybird predator *C. undecimpunctata* of the two seasons of 162.50(0-103) predators (Table, 5). Similar to the obtained results, the predator *C. undecimpunctata* was found to be the dominant predator associated with aphids in the wheat fields (Hafez, 1994; El-Heneidy et al., 2004a; El-Gapaly, 2007 and Youssif et al., 2017).

**The Occurrence of the Ladybird Predator *H. convergens***

The periods of the ladybird predator *H. convergens* occurrence extended from; (January to April, 2018 & 2019), in seasons 2017/2018 and 2018/2019, respectively (i.e., the periods of the ladybird predator *H. convergens* covered four months of the two studied seasons). The highest monthly total numbers of the ladybird predator *H. convergens* (46&87 predators) were recorded during February, 2018 and April, 2019 in seasons 2017/2018 and 201/2019, respectively. The total numbers of the ladybird predator *H. convergens* per season were; 72(0-46) & 124(0-87) predators, respectively, with a mean total number of the ladybird predator *H. convergens* of the two seasons of 98.00(0-87) predators (Table, 5). Similar to the obtained results, the predator *H. convergens* was recorded associated with aphids in the wheat fields by Nilsa et al. (2002) and Michaud & Vargas (2010).

The obtained monthly ratios between the surveyed coccinellids’ predators and the aphids’ species attacking the wheat plants were shown in Table (5), where, the most acceptable seasonal ratios between the surveyed coccinellids predators and the aphids’ species attacking the wheat plants were; 1:1.16 & 1:1.24, that were recorded during the two months of April, in 2017/2018 and 2018/2019 seasons, respectively. The seasonal ratios that were recorded between the surveyed coccinellids predators and the wheat aphids per season were; 1:14.21 & 1:13.98 predators in the case of seasons 2017/2018 and 2018/2019, respectively. The general ratio that was recorded between the surveyed coccinellids predators and the wheat aphids, for the two studied seasons was 1:14.09.

Statistical analysis of the obtained data (Table, 5) revealed that the comparisons between the two studied seasons 2017/2018 and 2018/2019 were recorded as follows:-
- No significant difference was obtained in case of comparing the total numbers of all predatory individuals (value =0.101&correlation=0.804).
- No significant difference was obtained in case of comparing the total numbers of the predatory stages (larvae & adults), (value = 0.073&correlation=0.843).
- No significant difference was obtained in case of comparing the total numbers of the predatory larvae (value = 0.020&correlation=0.934).
- A highly significant difference was obtained in case of comparing the total numbers of the predatory pupae (value = 0.833&correlation=0.132).
- A highly significant difference was obtained in case of comparing the total numbers of the predatory two ladybird adults; *C. undecimpunctata* and *H. convergens* together (value = 0.856&correlation = -0.113).
- A very highly significant difference was obtained in case of comparing the total numbers of the predatory adults of *C. undecimpunctata* (value = 0.908&correlation = -0.072).
- A moderate significant difference was obtained in case of comparing the total numbers of the predatory adults of *H. convergens* (value = 0.774&correlation = -0.179).

### Table 5: The monthly total numbers of common coccinellids ladybird predators’ individuals that were recorded associated with the wheat aphids’ species attacking the wheat plants, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

| Months          | Total no. of all individuals of predators | The common predatory stages (larvae & ladybird adults) | The predatory ladybird adults | Ratios (predators: aphids) |
|-----------------|------------------------------------------|------------------------------------------------------|--------------------------------|-----------------------------|
|                 | (L & P) | Total no. of larvae | Total no. of pupae | A | B |
| December, 2017 | 10 | 0 | 0 | 0 | 0 | 0 | 0.28 |
| January, 2018  | 10 | 10 | 10 | 6 | 4 | 0 | 1.152.00 |
| February       | 147 | 121 | 12 | 116 | 70 | 46 | 16 | 1.228.50 |
| March          | 129 | 152 | 112 | 45 | 26 | 17 | 4 | 1.108.89 |
| April          | 176 | 174 | 155 | 19 | 14 | 5 | 2 | 1.313.16 |
| Total/season   | 492 | 470 | 282 | 188 | 116 | 72 | 22 | 1.141.21 |
| (Mean/month)   | (98.40±38.44) | (94.60±37.09) | (56.40±23.52) | (37.60±20.85) | (23.20±12.46) | (14.40±8.39) | (4.40±2.99) |

A= the coccinellid predator *C. undecimpunctata*  
B= the coccinellid predator *H. convergens*  
L= predatory larvae  
A= predatory adults  

**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 Concerning the Natural Relationships Recorded Between the Wheat Aphids, the Aphids’ Parasitoids & the Coccinellids’ Predators, and the Weather Factors (Means of the Temperature & the Relative Humidity).

The relationships between the total numbers of the aphids’ individuals, the total numbers of the winged adults of the aphids’ species, the total numbers of the wingless individuals of the aphids’ species, the total numbers of the aphids’ mummies, the mean percentages of the aphids’ parasitism, the total numbers of all emerged parasitoids, the total numbers of the primary parasitoids, the total numbers of the secondary parasitoids & the total numbers of all individuals of the coccinellids ladybird predators (larvae, pupae & adults) and the means of the temperature and the relative humidity were shown in Table 6. Where the r-values and the corresponding f-values were recorded to represent such obtained relationships.
Table 6: Statistical analysis of many tested ecological factors, in relation to the means of temperature and relative humidity (r-values & the corresponding f-values), that were recorded in the wheat field, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

| Tested factors | 2017/2018 | 2018/2019 |
|----------------|-----------|-----------|
|                | r-value   | f-value   | r-value   | f-value   |
| 1. The total numbers of the aphids’ individuals. | R: 0.052 | 0.076 | 0.019 | 0.402 |
|                | F: 0.006 | 0.017 | 0.001 | 0.579 |
|                | Sign: 0.933*** | 0.804*** | 0.976*** | 0.567** |
| 2. The total numbers of the winged adults of the aphids’ species. | R: 0.387 | 0.255 | 0.126 | 0.367 |
|                | F: 0.528 | 0.208 | 0.049 | 0.466 |
|                | Sign: 0.520* | 0.679** | 0.840*** | 0.401 |
| 3. The total numbers of the wingless individuals of the aphids’ species. | R: 0.011 | 0.017 | 0.051 | 0.574 |
|                | F: 0.000 | 0.001 | 0.008 | 0.008 |
|                | Sign: 0.986**** | 0.979**** | 0.935**** | 0.904**** |
| 4. The total numbers of the aphids’ mummies. | R: 0.364 | 0.467 | 0.065 | 0.377 |
|                | F: 0.457 | 0.837 | 0.013 | 0.497 |
|                | Sign: 0.548* | 0.428 | 0.917*** | 0.532** |
| 5. The mean % of the aphids’ parasitism. | R: 0.683 | 0.810 | 0.159 | 0.376 |
|                | F: 2.626 | 5.722 | 0.077 | 0.494 |
|                | Sign: 0.204 | 0.097 | 0.799** | 0.532** |
| 6. The total numbers of all emerged parasitoids. | R: 0.180 | 0.378 | 0.220 | 0.184 |
|                | F: 0.101 | 0.498 | 0.153 | 0.153 |
|                | Sign: 0.772** | 0.521* | 0.722** | 0.767** |
| 7. The total numbers of the primary parasitoids. | R: 0.539 | 0.416 | 0.835 | 0.533 |
|                | F: 1.227 | 0.626 | 6.882 | 1.189 |
|                | Sign: 0.349 | 0.486 | 0.079 | 0.355 |
| 8. The total numbers of the secondary parasitoids. | R: 0.487 | 0.632 | 0.116 | 0.426 |
|                | F: 0.932 | 1.993 | 0.041 | 0.666 |
|                | Sign: 0.405 | 0.253 | 0.853*** | 0.474 |
| 9. The total numbers of all individuals of the coccinellids’ ladybird predators (larvae, pupae & adults). | R: 0.930 | 0.924 | 0.888 | 0.151 |
|                | F: 27.702 | 17.627 | 11.154 | 0.070 |
|                | Sign: 0.013 | 0.025 | 0.044 | 0.808*** |

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

The Statistical Analysis Relationships that Were Recorded with the Means of the Temperature.

The statistical analysis that was obtained between some ecological features concerning the aphids’ species & the common natural enemies (including; the parasitoids and the predatory ladybird coccinellids) and the means of the temperature, that were recorded during the two successive seasons, 2017/2018 and 2018/2019, in the wheat fields in Qalubia Governorate, were shown as follows:

1. There were; (a very highly significant difference =0.933****) & (a very highly significant difference =0.976****) between the total numbers of the aphids’ individuals and the means of temperature ((r-value=0.052 & f-value=0.008) & (r-value=0.019 & f-value=0.001)), in seasons 2017/2018 and 2018/2019, respectively).

2. There were; (a significant difference =0.520*) & (a highly significant difference =0.840****) between the total numbers of the winged adults of the aphids’ species and the means of temperature ((r-value=0.387 & f-value =0.528) & (r-value=0.126 & f-value=0.049)), in seasons 2017/2018 and 2018/2019, respectively).

3. There were; (a very highly significant difference =0.986****) & (a very highly significant difference =0.935****) between the total numbers of the wingless individuals of the aphids’ species and the means of temperature ((r-value=0.011 & f-value=0.000) & (r-value=0.051 & f-value=0.008)), in seasons 2017/2018 and 2018/2019, respectively).
4-There were; (a significant difference =0.548*) & (a very highly significant difference =0.917****) between the total numbers of the aphids’ mummies and the means of temperature ((r-value=0.364 & f-value=0.457) & (r-value=0.065 & f-value=0.013)), in seasons 2017/2018 and 2018/2019, respectively).

5-There were; (no significant difference =0.204) & (a moderate significant difference =0.799**) between the mean percentages of the aphids’ parasitism and the means of temperature ((r-value=0.683 & f-value=2.626) & (r-value=0.159 & f-value=0.077)), in seasons 2017/2018 and 2018/2019, respectively).

6-There were; (a moderate significant difference =0.772**) & (a moderate significant difference =0.722**) between the total numbers of all emerged parasitoids and the means of temperature ((r-value=0.180 & f-value=0.101) & (r-value=0.220 & f-value=0.153)), in seasons 2017/2018 and 2018/2019, respectively).

7-There were; (no significant difference =0.349) & (no significant difference =0.079) between the total numbers of the primary parasitoids and the means of temperature ((r-value=0.539 & f-value=1.227) & (r-value=0.835 & f-value=6.882)), in seasons 2017/2018 and 2018/2019, respectively).

8-There were; (no significant difference =0.405) & (a highly significant difference =0.853***+) between the total numbers of the secondary parasitoids and the means of temperature ((r-value=0.487 & f-value=0.932) & (r-value=0.116 & f-value=0.041)), in seasons 2017/2018 and 2018/2019, respectively).

9-There were; (no significant difference =0.013) & (no significant difference =0.044) between the total numbers of all individuals of the coccinellids’ ladybird predators (larvae, pupae & adults) and the means of temperature ((r-value=0.950 & f-value=27.702) & (r-value=0.888 & f-value=11.154)), in seasons 2017/2018 and 2018/2019, respectively).

**The Statistical Analysis Relationships that Were Recorded with the Means of the Relative Humidity.**

The statistical analysis relationships that were obtained between some ecological features concerning the aphids’ species & the common natural enemies (including; the parasitoids and the predatory ladybird coccinellids) and the means of the relative humidity, that were recorded during the two successive seasons, 2017/2018 and 2018/2019, in the wheat fields in Qalubia Governorate, were shown as follows:

1-There were; (a very highly significant difference =0.904****) & (a significant difference =0.502*) between the total numbers of the aphids’ individuals and the means of relative humidity (r-value=0.076& f-value=0.017& (r-value=0.402 & f-value=0.579)), in seasons 2017/2018 and 2018/2019, respectively).

2-There were; (a moderate significant difference =0.679**) & (no significant difference =0.401) between the total numbers of the winged adults of the aphids’ species and the means of relative humidity ((r-value=0.255 & f-value=0.208) & (r-value=0.367 & f-value=0.466)), in seasons 2017/2018 and 2018/2019, respectively).

3-There were; (a very highly significant difference =0.979****) & (a significant difference =0.504*) between the total numbers of the wingless individuals of aphids and the means of relative humidity ((r-value=0.017 & f-value=0.001) & (r-value=0.574 & f-value=0.008)), in seasons 2017/2018 and 2018/2019, respectively).

4-There were; (no significant difference =0.428) & (a significant difference =0.532*) between the total numbers of the aphids’ mummies and the means of relative humidity ((r-value=0.467 & f-value=0.837) & (r-value=0.377 & f-value=0.497)), in seasons 2017/2018 and 2018/2019, respectively).

5-There were; (no significant difference =0.097) & (a significant difference =0.533*) between the mean percentages of the aphids’ parasitism and the means of relative humidity
(r-value=0.810 & f-value=5.722) & (r-value=0.376 & f-value=0.494)), in seasons 2017/2018 and 2018/2019, respectively).
6-There were; (a significant difference =0.531*) & (a moderate significant difference =0.767**) between the total numbers of all emerged parasitoids and the means of relative humidity ((r-value=0.378 & f-value=0.499) & (r-value=0.184 & f-value=0.153)), in seasons 2017/2018 and 2018/2019, respectively).
7-There were; (no significant difference =0.486) & (no significant difference =0.355) between the total numbers of the primary parasitoids and the means of relative humidity ((r-value=0.416 & f-value=0.626) & (r-value=0.533 & f-value=1.189)), in seasons 2017/2018 and 2018/2019, respectively).
8-There were; (no significant difference =0.253) & (no significant difference =0.474) between the total numbers of the secondary parasitoids and the means of relative humidity ((r-value=0.632 & f-value=1.993) & (r-value=0.426 & f-value=0.666)), in seasons 2017/2018 and 2018/2019, respectively).
9-There were; (no significant difference =0.025) & (a highly significant difference =0.808***) between the total numbers of all individuals of the coccinellids’ ladybird predators (larvae, pupae & adults) and the means of relative humidity ((r-value=0.924 & f-value=17.627) & (r-value=0.151 & f-value=0.070)), in seasons 2017/2018 and 2018/2019, respectively).

However, many investigators made very important attention to the relationships that existed between the ecological features and the weather factors (especially the temperatures and the relative humidity). For example, Mohamed and Ghanin (2008) demonstrated that it is necessary before introducing any predator in a biological control program to indicate its efficacy under the different environmental factors, where, among these factors; the prey type, the temperature, and the relative humidity are considered the most important ones.

**Conclusion**

The recent effective biological control programs often require a good understanding of the biology of the pest and its natural enemies, as well as the ability to identify the various life stages of the relevant insects in the field. The extensive field observations usually are necessary to monitor the natural enemies’ activity, evaluate the impact on the pest populations, and anticipate the need for any additional control measures. As a result, this study was conducted for helping to shed light on the biocontrol agents found in the wheat fields. So, it was concluded from the present study the following:

1-The occurrence periods recorded of the aphids’ species were extended from December to April, in 2017/2018 and 2018/2019 seasons. The total numbers of the wingless individuals were higher in comparison with those of adults ones on the wheat plants. In addition, the recorded aphids’ population in the second season (2018/2019) was relatively higher as compared with that recorded in the first one (2017/2018).
2-Surely, the natural enemies play an important natural role against the aphids’ species in the wheat fields, this conclusion was in agreement with that of Nirmala et al. (1996) who stated that, in a balanced ecosystem, the insects’ pests are kept in check by the occurrence of their natural enemies. Also, Sabbour (2007) found that, in the absence of the natural enemies, the pest species is able to reproduce unhindered population and the result is a rapid pest increase. Studying the natural role of the biological control agents (parasitoids & predators) and knowing the most efficient ones has been become a very important goal of the biological control programs, for their future uses against insects’ pests (Abul-Fadl et al., 2005). Learning the principal ecology and the biological control methods (by recognizing, managing, and conserving the common natural enemies), can help to reduce the pests’ populations and maintain them below the economic injury levels. So, the success in the biological control applications will decrease the crop losses and the need for any more costly control measures.
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(that also may have undesirable environmental side effects). For example, Ibrahim and Megahed (2017) indicated that the effective I.P.M. program always needs more and more of the recently collected information about the pest’s biology, ecology, and hosts range (the economic and the alternative plant hosts) to employ this information in forecasting the program and to take the decision for controlling the cotton aphid *Aphis gossypii* Glov. at a suitable time.

3-The periods where the natural occurrence is higher in the wheat fields must be avoided when applying any chemical control to save the natural balance between insect pests and their natural enemies. Therefore, El-Heneidy et al. (1991) indicated that the early infestation of aphids in wheat fields should be chemically treated only in the infested spots, so less influence will be happening on the natural enemies. They concluded that the applied I.P.M. programs for the aphids control depend on the positive role of the parasitoids and the predators and are always needed to reduce the dependence on the currently used programs of the chemical insecticides. Also, Messina and Soureson (2001) showed that the impact of this natural interaction could be either negative or positive one that has cumulative effects on the reduction of the aphids’ populations.

4-The aphids’ parasitoids were immediately present in the wheat field after the occurrence of the aphids’ infestation, where the percentages of the aphids’ species parasitism were relatively lower in the growing studied seasons 2017/2018 and 2018/2019. The recorded primary parasitoids could be arranged according to the mean percentages of their occurrence to each other for the two seasons of the study as follows: *A. colemani* (52.03% (0.00-56.66%)) > *Ephedrus* sp. (33.94% (0.00-54.55%)) > *Lysiphlebus* sp. (10.41% (0.00-18.18%)) > *D. rapae* (3.62% (0.00-14.28%)), of the total percentages of all primary parasitoids’ species occurrence, (i.e., the primary parasitoid *A. colemani* was the predominant parasitoid species recorded attacking the aphids’ species in the wheat fields). Also, the obtained results demonstrated that the total numbers of the secondary parasitoids’ species were higher in the first season (2017/2018) in comparing with the second one (2018/2019). The secondary parasitoids’ species; *Dendrocerus* spp. (Megaspilidae, where the mean percentage of occurrence =65.50%) > pteromalids spp. (Pteromalidae, where the mean percentage of occurrence =34.40%), were the only recorded secondary parasitoids (the hyperparasitoids) during this study. The period of their occurrence extended from January to April, in the two seasons 2017/2018 and 2018/2019 (i.e., the period of the secondary parasitoids’ species occurrence covered four months, in case of the two studied seasons). The mean total numbers of the secondary aphids’ parasitoids were higher than those of the primary one in the case of the two seasons separately and also in case of the general ratio between them of the two studied seasons.

5-The two coccinellids’ predatory species; *C. undecimpunctata* and *H. convergens*, were the only recorded coccinellids’ predators that had the highest occurrence during this study. The period of their occurrence extended from January to April, in seasons 2017/2018 and 2018/2019 (i.e., the period of the coccinellids’ predatory species occurrence covered the four months of the two seasons of the wheat cultivation).

6-Generally, the natural sequence role of the primary parasitoids and the two major ladybirds’ predators; *C. undecimpunctata* and *H. convergens* must be continuously encouraged and developed by maintaining the suitable safe conditions to play and to naturally increase this role. Moreover, the primary parasitoid *A. colemani* can be used early in the wheat season in January and the two ladybird predators *C. undecimpunctata* and *H. convergens* can be used later in the wheat season in March and April. They can be massed reared in the laboratory and released for controlling the aphids’ species attacking the wheat plants or the other related plants that are subjected to the aphids’ infestation. Therefore, a positive integration period between the two biocontrol agents will be happening during the
whole period of the highest aphids’ infestation to the wheat plants from January until April. Similarly, 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. However, Ahmed (1995) revealed that the aphidiid parasitoids of aphids are one of the groups that are important widespread, whose utilization in the field of biological control has given significant control results. Several attempts have been made worldwide to introduce the cereal aphids’ natural enemies such as parasitoids for the biological aphids’ control (Levie et al., 2005). In addition, Mondor and Warren (2000) revealed that aphids are one of the serious groups of insects’ pests that attack green plants, therefore, their natural enemies have received high attention through extensive studies, mass rearing, and releasing techniques of them. Also, Bahy El-Din et al. (2013) found that the coccinellid predator *H. convergens* was a potential predator that can be successfully used for the biological control of the cotton aphid *A. gossypii*.

Fig. (1): Photos representing the field infestation of the wheat plants by the aphids’ species that was recorded during the present study.

Fig. (2): Photos representing the formed mummies of the aphids’ parasitoids that were recorded after the aphids’ parasitism in the wheat fields, during the present study.
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**Fig. (3):** The monthly total numbers of the primary & the secondary parasitoids’ species, that were recorded associated with the aphids’ species in the wheat fields, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

**Fig. (4):** Photos representing the ladybird adults’ predators that were recorded associated with the aphids’ species, during two different developing stages of wheat plants in the present study.
Fig. (5): The monthly total numbers of the aphids’ species, the total numbers of the aphids’ mummies and the total numbers of the common coccinellids’ ladybird individuals, in relation to the means of the temperature and the relative humidity, that was recorded in the wheat fields, during 2017/2018 and 2018/2019 seasons, in Qalubia Governorate.

Fig. (6): A photo representing the field natural integration that was recorded between the two biocontrol agents; the coccinellids’ predators and the aphids’ parasitism (that were represented by the occurrence of the parasitoids’ mummies), on the wheat plants during the study.
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ARABIC SUMMARY

دراسات بيئية على التفاعل البيولوجي الحادث بالمفترسين Coccinella undecimpunctata L. و Coccinella convergens Guer. (Coleoptera: Coccinellidae)، والتالي لعملية التطفل الأولى للمن على نباتات القمح في المحافظة القليوبية

تغطي عامين من الاكتشاف النهائي التحليلي للظروف التي تواجه نباتات القمح في مصر، بداية من تاريخ الزراعة حتى وقت الحصاد للمحصول. ولذا، فقد أجريت هذه الدراسة الهيكلية لتقييم كثافة التعداد لأنواع من القمح، الطفيليات المرتبطة (الأولية والثانوية) وكذلك المفتشين الشائعين من عائلة Coccinellidae، في محافظة القليوبية. تم أيضا دراسة العلاقات الإيجابية والسلبية التي تواجدت بين أنواع من القمح، وتلك الأعداء الحيوية، حيث أنه من الضروري لبرامج المكافحة الحيوية الناجحة معرفة نشاط الأعداء الحيوية وتقدير مدى التأثير على تعداد الآفات، وكذلك تحديد مدى الاحتياج لتطبيق طرق أخرى إضافية لمكافحة الآفات.

أظهرت النتائج المتصلحة عليها أن فترات التواجد لأنواع من نباتات القمح، قد أدت خلال فترة الدراسة، إلى تغيير في كمية القمح، وال anmeld (أي في الفترة الممتدة من ديسمبر حتى أبريل) في السنة المصممة 2017/2018، و 2018/2019، وسجل تواجد فترات القمح، التي تبدأ من فترات التكاثر، من دون أن تكون ثابتة في الفصل الأول من السنة. اكتشفت نتائجنا أن الأعداء التي تواجدت في الفصل الثاني، مثل الزحفة الأرضية، تلامس نباتات القمح، وتؤثر على العقول. 

نستنتج أن الاستدامة في نباتات القمح تتأثر بانتظام في موسم الدراسة، وبالتالي متواجد الأنواع، فكان الطفيل الأولي, Aphidius colemani Viereck, هو الأكثر انتشارًا وانتشارًا في موسم الدراسة. وتوصي النتائج بتعمق دراسة الأنواع والأنواع المختلفة، كالأعداء الحيوية، لتقدير مصادر نباتات القمح في المحافظة القليوبية.
Ecological Studies on the Biological Integration Occurred by the Two Predators

Mehajmaa لأنواع المن في حقول القمح مقارنة بباقي الطفيليات الأولى الأخرى المسجلة. ورتب الطفيليات الأولية المنسجلة تبعاً لمسارها نسباً للمسجلين كالتالي: 

\( 33.94\% \text{ persicae Froggatt}) \ E. \text{Ephedrus sp. (mostly } 52.03\% \text{ (0.00-56.66\%)}) > \text{ colemani A. Mcintosh rapae sp. (10.41\% (0.00-18.18\%)}) > \text{ Dialeteriella (0.00-54.55\%)) > Lysiphlebus (3.62\% (0.00-14.28\%)), (Aphidiidae). }

أما بالنسبة للطفيليات الثانوية، فقد زاد تعدادها الكلي في الموسم الأول مقارنة بالتعليم في الموسم الثاني، وأيضاً كانت هي الأعلى في تعادها الكلي مقارنة بالطفلات الأولية، في كلا موسمي الدراسة. بينما كان تواجدها تبعاً لمستوط نسب تتواجدها لبعضها البعض للموسمين كالتالي:

\( \text{spp. pteromalids } > (65.50\%) \text{ (Megaspilidae) sp. Dendrocerus spp. }

كما وامتدت فترة التواجد لهذه الطفيليات الثانوية لتشمل الفترة من شهر يناير حتى شهر أبريل في كلا موسمي الدراسة. بينما كان تواجدها تبعاً لمستوط نسب تتواجدها لبعضها البعض للموسمين كالتالي:

\( Dendrocerus spp. (Megaspilidae) (65.50\%) > \text{p.teromalids spp. (Pteromalidae) (34.40\%)}.

ومازمدة فترة التواجد لتلك المفترسات المسجلة لتشمل الفترة من شهر يناير حتى شهر أبريل في كلا موسمي الدراسة، مما يعني أن تلك المفترسات قد تواجدها فترة أربعة أشهر متواجدة في موسم زراعة القمح.

ولذا، فإن الدور الطبيعي المتتابع للمتعاقب لكل نوع كائنات المكافحة الحيوية المسجلة: والذي يشمل الطفيليات H. و C. undecimpunctata A. colemani، و A. colemani، وكذلك أيضا المفترسات الشععيين conservegns ، يجب أن يتوافق باستمرار لتنشيطه وترشيده وتنبيهه في حقول الفحص التي تتكيف بالمساء، وذلك بتكييف النشاطه على توجيه الظروف المناسبة وتوفر المكافحة الكيميائية، واختيار الأوقات المناسبة لعمليات المكافحة وحول التواجد الطبيعي لهذه الكائنات الحيوية السابقة، فيمكن أكثر من كمية في المعامل وإطلاقها في حقول القمح أو الحقول الأخرى التي تصاب بال فيه.

I.P.M. Integrated Pest Management (Management of pests)/البيئة حياة من التلوث، ويعتبر أن يكون هذا الاستخدام في إطار منظمة شاملة للمكافحة الكاملة للأطعمة.