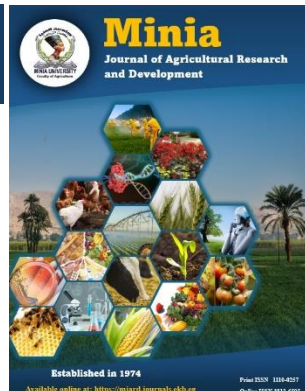




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Insect survey and population density of main insect pests and natural enemies inhabiting wheat plants in Minia Region, Minia, Egypt.

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ABSTRACT

The present study was conducted to survey the insects inhabiting wheat fields and to determine the population densities of major pests and their associated natural enemies in the Minia region, Minia Governorate, Egypt, during two successive wheat seasons (2023/24 and 2024/25). Weekly data (direct counts and sweep-net collections) revealed the presence of 20 insect species belonging to 15 families and 10 orders, 12 of them were identified as pests, 7 as predators, and one as a parasitoid. Three cereal aphid species, *Rhopalosiphum padi*, *Schizaphis graminum*, and *Sitobion avenae*, were recorded as the dominant wheat pests. *R. padi* was the most abundant. While the most abundant natural enemies were *Coccinella undecimpunctata*, *Metasyrphus corollae*, *Chrysoperla carnea*, and *Aphidius* sp. In the same time, all of them showed significant seasonal fluctuations and highly densities in the second year.

Statistical analysis indicated no significant difference in aphid populations density between the two seasons. But the populations of *C. undecimpunctata*, *M. corollae*, and *Aphidius* sp. increased significantly in the second season ($p < 0.05$).

Keywords: Wheat, aphids, insect pests, natural enemies, Minia, biological control, field survey, t-test.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most widely grown cereal crop globally and is a staple food in Egypt. Despite its importance, Egypt consumes the equivalent 20 million metric tons (t) of wheat per year, and less than half of this amount is met from domestic production, (Abdalla *et al.*, 2023). Due to production shortfalls, which are partially attributed to pest infestations.

Most of these pests infesting wheat belong to seven major orders: Orthoptera, Homoptera, Hemiptera, Coleoptera, Diptera, Lepidoptera, and Hymenoptera. Among those pests, cereal aphids are gaining importance since their population has increased over the last few years (El-Serafy, 1999; El-Heneidy *et al.*, 2004; Ahmad *et al.*, 2016; Awadalla *et al.*, 2018 and El Dessouki *et al.*, 2022). Aphids are a serious

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insect pest attacking wheat plants in Egypt, they damage wheat by sucking plant sap and transmitting viral diseases, leading to yield losses ranging from 7.5% to 18.7% (**Tantawi, 1985**). The overreliance on chemical pesticides has resulted in healthy risks, resistance, and the destruction of beneficial organisms. Therefore, this study focuses on identifying some of the pest species and their natural enemies associated with wheat plants, in addition to population density.

MATERIALS AND METHODS

The present study was conducted to survey insect pests inhabiting wheat plants and their associated natural enemies in Minia district, Minia governorate, Egypt, during two successive seasons, 2023/2024 and 2024/2025. Three replicates (Plot dimensions: 3.5 W. X 4 L. = 14 m²) were sown by wheat cultivar Giza171, however the date of sown was in the third week of November. Normal agricultural practices were carried out. No insecticides were used throughout the two studied seasons. All stages of the main insect pests and associated natural enemies were recorded.

Samples were collected every 3-4 days (two samples every week) during the two successive growing seasons 2023/24 – 2024/25, as soon as the appearance of the insect pests' individuals, and continued until their disappearance. Visual counts of insect

individuals were used according to (**Dewar *et al*, 1982**). Also, natural enemies were counted by using the sweep-net technique 10 double sweeps every 3-4days according to (**Southwood, 1978**).

The collected specimens were kept in vials containing 70% ethyl alcohol to keep their tissues soft and labeled with the date. The identification of aphids was carried out according to the key of Aphididae which described by (**Habib and El-Kady, 1961 and Helmi, 2011**), also by some of the staff members in the Department of Plant Protection, Minia University, Minia, Egypt. A T-test analysis was performed for each species.

RESULTS AND DISCUSSION

1. General survey of insects inhabiting wheat plants.

Sampling was carried out every 3-4 days (two samples/week) during the two successive growing seasons, 2023/2024 and 2024/2025.

Data in Table (1) represent the insects recorded at the experimental site (Minia District) in Minia Governorate according to orders, families and insect species. The results revealed the presence of 20 insect species belonging to 15 families of 10 orders. From the arthropod species collected, 12 species were considered pests, 7 predators and 1 species was a parasitoid.

Table 1: List of insects inhabiting Wheat plants (*Triticum aestivum* L.) in Minia region during the two seasons of (2023\24) and (2024\25).

Order	Family	Scientific name	Period of occurrence	Notes ⁽¹⁾
Coleoptera	Carabidae	<i>Calosoma chlorostictum</i>	Jan. – Feb.	B 1
	Chrysomelidae	<i>Oulema melanopus</i> L.	January	A 1
	Coccinellidae	<i>Coccinella septempunctata</i>	Jan. – May	B 1.2
		<i>Coccinella undecimpunctata</i>	Jan. – May	B 1.2
Dermaptera	Labiduridae	<i>Lapidura riparia</i> P.	Jan. – Feb.	B 1
Diptera	Syrphidae	<i>Metasyrphus corollae</i> F.	Jan. – April	B 1.2
Hemiptera	Pentatomidae	<i>Nezara viridula</i> L.	Dec. – Feb.	A 1
	Miridae	<i>Nesidiocoris tenuis</i> R.	Nov. – Dec.	B 1
Hymenoptera	Braconidae	<i>Aphidius</i> sp	Feb. – April	B 1.2
Homoptera	Aphididae	<i>Schizaphis graminum</i> R.	Jan. – April	A 1
		<i>Rhopalosiphum padi</i> L.	Jan. – May	A 1
		<i>Sitobion avenae</i> F.	Feb.– March	A 1
	Jassidae	<i>Empoasca</i> spp	Nov. – March	A 1.2
Lepidoptera	Noctuidae	<i>Spodoptera exigua</i>	Jan. – March	A 1
		<i>Spodoptera littoralis</i> B.	Jan. – Feb.	A 1
Neuroptera	Chrysopidae	<i>Chrysoperla carnea</i> S.	Jan. – May	B 1.2
Orthoptera	Acrididae	<i>Anacridium aegyptium</i>	Nov. – May	A 1
		<i>Thisoicetrus littralis</i>	Nov. – May	A 1
	Gryllotalpidae	<i>Gryllotalpa gryllotalpa</i> L.	Jan. – Feb.	A 1
Thysanoptera	Thripidae	<i>Thrips</i> spp	Dec. – April	A 1.2

These results were based on twice-weekly samples collected by:

1- Direct count

2- Sweep net technique

A – Pest

B – Predator / Parasitoid

1.2 Main insect pests inhabiting wheat plants.

1.2.1 Population densities of main insect pests infesting wheat plants during the 2023/2024 and 2024/2025 seasons.

1.2.2 Population density of Bird cherry-oat aphid *R. padi*.

Data given in Table (2) and illustrated in Fig. (1) show the mean number of *R.padi* during 2023/24 season. The first appearance of this aphid species occurred during the 4th week of January (6.33 insects). The population increased

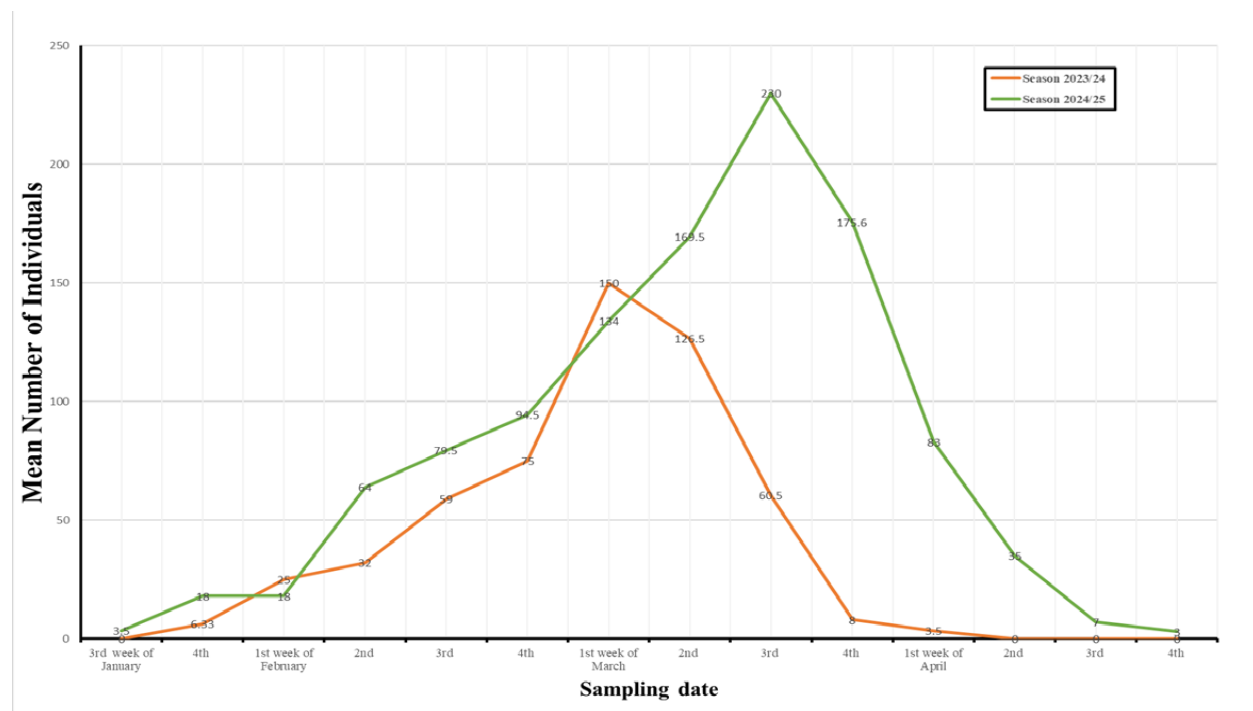
gradually and reached the highest peak (150 individuals) during 1st week of March. Then the population decreased gradually till the end of the season. In the 2024/25 season, the first appearance of this aphid species occurred during the at 3rd week of January (3.5 insects were recorded) then, the number increased rapidly to reach its highest peak at the 3rd week of March, with an average number of 230 individuals. similarly, also the numbers decreased gradually till the end of the season. (Table 2 and fig 1)

Table 2: Mean number of *Rhopalosiphum padi* during the two successive seasons of 2023/24 and 2024/25.

Sampling date ^(1,2)	Weekly mean number of individuals	
	Season 2023/24	Season 2024/25
3 rd week of January	0	3.5
4 th	6.3	18
1 st week of February	25	18
2 nd	32	64
3 rd	59	79.5
4 th	75	94.5
1 st week of March	150	134
2 nd	126.5	169.5
3 rd	60.5	230
4 th	8	175.67
1 st week of April	3.5	83
2 nd	0	35
3 rd	0	7
4 th	0	3
General Mean	38.98	79.61

(1) Weekly counts based on two counts every 3-4 days

(2) Samples based on 3 replicates (10 tillers \ replicate)

**Figure 1: Population density of *Rhopalosiphum padi* during two successive seasons, 2023/24 and 2024/25.**

1.2.3 Population density of green cereal - bug aphid *S. graminum*.

The result in Table (3) and in Fig. (2) present mean number of *S. graminum* during 2023/24 season. The first appearance of this aphid species occurred during the 4th week of January (2 individuals). However, the population increased gradually to reach two peaks, 9.5 and 9.5, during the 3rd week of February and the 1st week of March.

Followed by a gradual decrease till the end of the season. In the 2024/25 season, the first appearance occurred at the 4th week of January, (4 insects), then the number increased to reach its highest peak at the 1st week of February, with an average number of (14 individuals) and a second peak at the 3rd week of March, (7.5 insects). At the same season, the numbers decreased gradually till the end of the season.

Table 3: Mean number of *Schizaphis graminum* during the two successive seasons of 2023/24, 2024/25.

Sampling date ^(1,2)	Weekly mean number of individuals	
	Season 2023/24	Season 2024/25
4th week of January	2	4
1st week of February	4.5	14
2 nd	3	0.5
3 rd	9.5	6
4 th	4	0
1st week of March	9.5	0.5
2 nd	8.5	3.5
3 rd	1	7.5
4 th	0.5	3.3
1st week of April	0	1.5
2 nd	0	0
3 rd	0	0.5
4 th	0	3
-	-	-
General Mean	3.26	3.41

(1) Weekly counts based on two counts every 3-4 days

(2) Samples based on 3 replicates (10 tillers \ replicate)

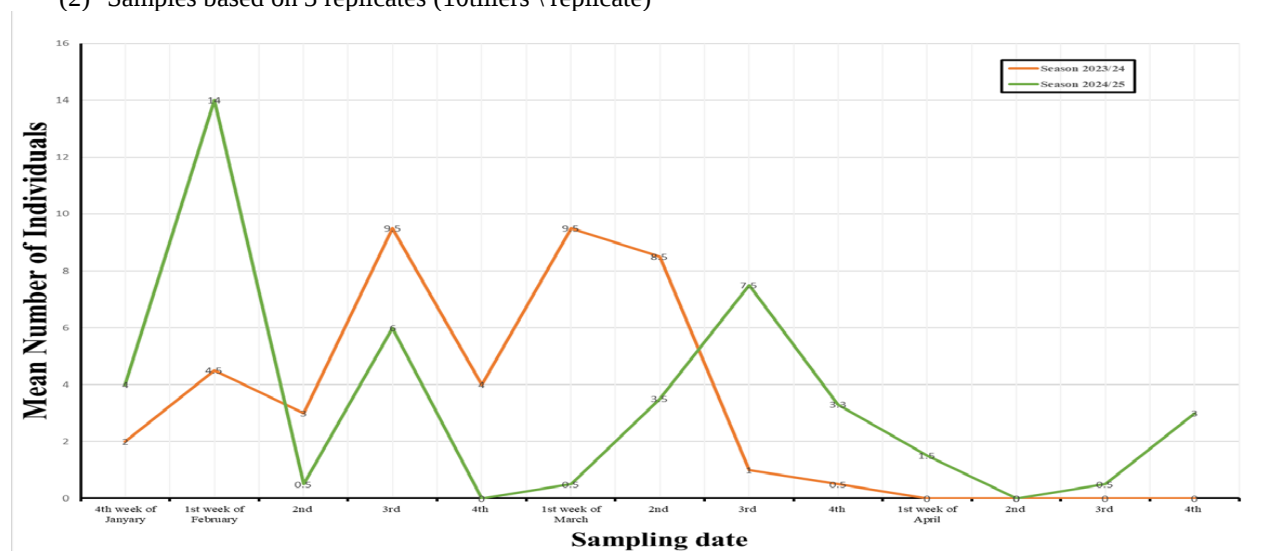


Figure 2: Population density of *Schizaphis graminum* during the two successive seasons of 2023/24 and 2024/25.

1.2.4 English grain aphid, *Sitobion avenae*

Sitobion avenae appeared in few numbers only in the second season 2024/25, and attacked wheat plants from the last week of February to the end of March. The total number of individuals was 43 for the entire second season.

1.3 Population densities of the natural enemies associated with certain insect pests infesting wheat plants during the 2023/2024 and 2024/2025 seasons.

1.3.1 The population density of eleven-spot ladybird *C. undecimpunctata*:

The population density of *C. undecimpunctata* individuals on wheat plants of the two studied seasons of 2023/24 and 2024/25 is summarized in Table (4), and graphically demonstrated in Fig. (3). The population of *C. undecimpunctata* was

detected in all sampling dates of first season 2023/24 and the first appearance occurred at the 1st week of January with an average number of one individual, it had two peaks at the 1st week of February and 4th week of February with average numbers of 6.5 and 9 individuals/10 double sweeps, respectively. Then the numbers decreased gradually and disappeared at the end of the season. In the second season 2024/25, the predator started to appear on wheat plant plots during the 4th week of December with an average number of 2 individuals, then the number increased to reach its highest peak in the 4th week of March with mean number of 59 individuals/10 double sweeps. The numbers decreased gradually till the end of the season.

It's obvious that the density of eleven lady bird extensively higher in the second season than first season it reached more than 9-fold higher in total density

Table 4: Mean number of *C. undecimpunctata* during the two successive seasons of 2023/24 and 2024/25

Sampling date ^(1,2)	Weekly mean number of individuals	
	Season 2023/24	Season 2024/25
4 th week of December	0	2
1 st week of January	1	2
2 nd	2	5
3 rd	1	1
4 th	1.67	8.3
1 st week of February	6.5	8
2 nd	1.5	4.5
3 rd	3	11
4 th	9	9
1 st week of March	1.5	13
2 nd	0	35
3 rd	0.5	38.5
4 th	1.5	59
1 st week of April	2	49.5
2 nd	0.5	28.5
3 rd	0	18
4 th	0	11
General Mean	1.86	17.84

(1) Weekly counts based on two counts every 3-4 days

(2) Samples based on 3 replicates (10 tillers \ replicate) – 10 double sweeps were made.

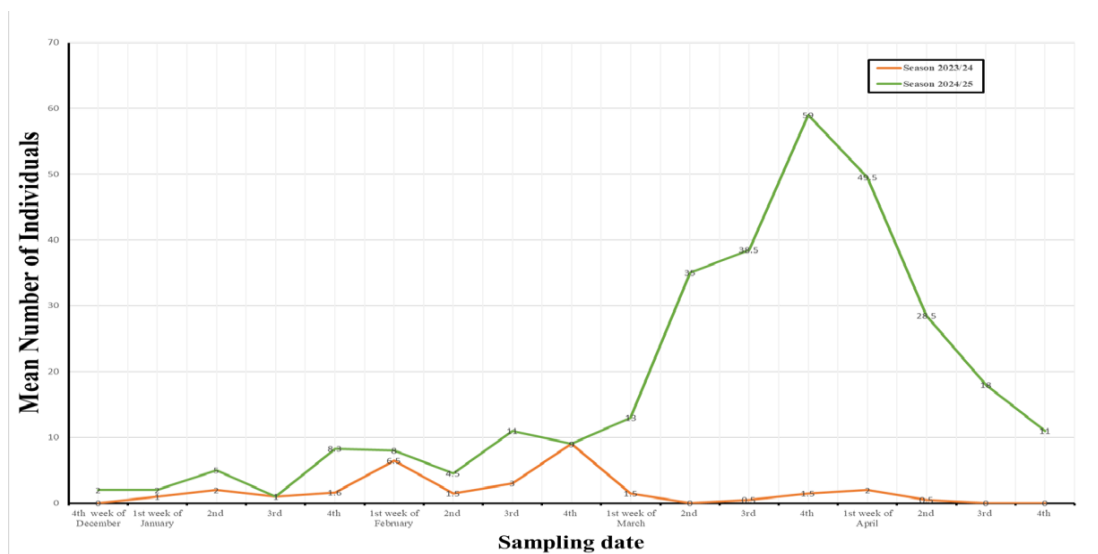


Figure 3: Population density of *C. undecimpunctata* during the two successive seasons of 2023/24 and 2024/25.

1.3.2 The population density of *M. corollae*:

Data given in Table (5) and illustrated in Fig. (4) show the mean number of *M. corollae* which appeared during two seasons, 2023/24 and 2024/25. The first appearance occurred at the 1st week of January with a rare number of one individual. The population is slowly showing the highest peak of abundance at the 4th week of February (8.3 /10 double sweeps) in the first season 2023/24.

In 2024/25, the appearance also occurred at the 1st week of January. Then, the predator numbers reached their peaks in the 1st week and the 4th week of March, with (18.5 and 21.6 individuals /10 double sweeps, respectively).

It's clearly obvious that the occurrence of the syrphid predator was higher in the second season than in the first, and this is probably due to the increased number of aphids in the second season than in the first one.

Table 5: Population density of *M. corollae* during the two successive seasons of 2023/24 and 2024/25

Sampling date ^(1,2)	Weekly mean number of individuals	
	Season 2023/24	Season 2024/25
1 st week of January	1	2
2 nd	2	1
3 rd	1	5.5
4 th	1.5	4
1 st week of February	4.5	9
2 nd	3.5	12
3 rd	3	13
4 th	8.3	9
1 st week of March	2.5	18.5
2 nd	1.5	15
3 rd	1	16
4 th	0.5	21.67
1 st week of April	0	13.5
2 nd	0	6.5
3 rd	0	4.5
4 th	0	2
General Mean	1.89	9.57

(1) Weekly counts based on two counts every 3-4 days

(2) Samples based on 3 replicates (10 tillers \ replicate) – 10 double sweeps were made.

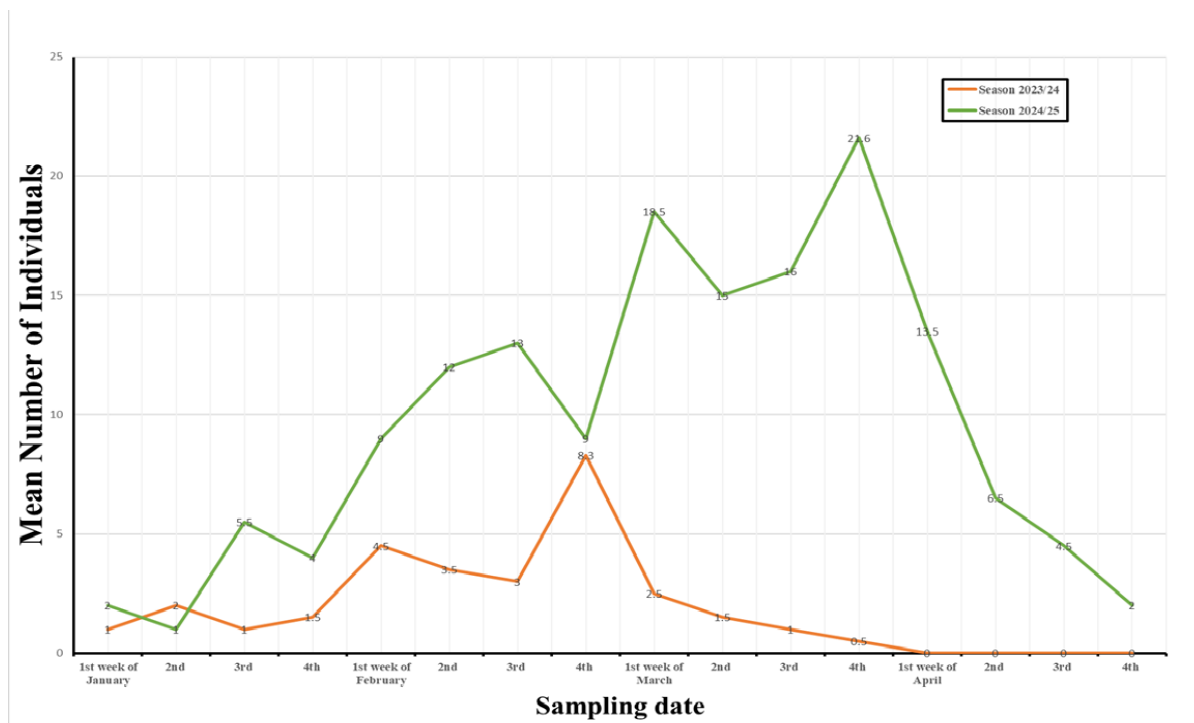


Figure 4: Population density of *M. corollae* during the two successive seasons of 2023/24 and 2024/25.

1.3.3 The population density of the green lacewing *Ch. carnea*:

Data in Table (6) present the weekly average numbers of *Ch. carnea* in both seasons recorded from the first week of January and 4th week of January till the end of the two seasons. The first appearance occurred with an average number of one individual. However, the density of the predator showed two peaks in 2023/24 season, in the 2nd week of February and the 4th week of February with mean numbers of 6 and 12 individuals/ 10 double sweeps,

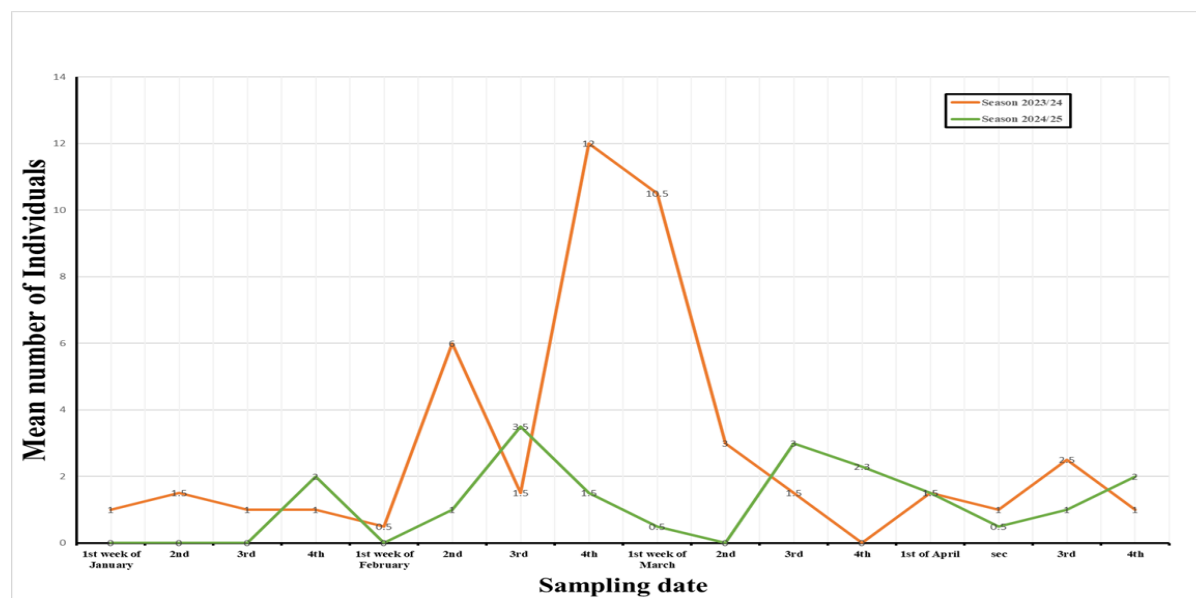
respectively Fig. (5). On the other hand, in 2024/25 season the first appearance occurred at the 2nd week of February with an average number of one individual, showing two peaks in the 3rd week of February and the 3rd week of March with mean numbers of 3.5 and 3 individuals/ 10 double sweeps respectively, And it was obvious that the Chrysoperla was relatively lower in the second season and appeared lately than in the first season, probably due to competition with other predators.

Table 6: Population density of *Ch. carnea* during the two successive seasons of 2023/24 and 2024/25

Sampling date ^(1,2)	Weekly mean number of individuals	
	Season 2023/24	Season 2024/25
1 st week of January	1	0
2 nd	1.5	0
3 rd	1	0
4 th	1	2
1 st week of February	0.5	0
2 nd	6	1
3 rd	1.5	3.5
4 th	12	1.5
1 st week of March	10.5	0.5
2 nd	3	0
3 rd	1.5	3
4 th	0	2.3
1 st week of April	1.5	1.5
2 nd	1	0.5
3 rd	2.5	1
4 th	1	2
General Mean	2.84	1.17

(1) Weekly counts based on two counts every 3-4 days

(2) Samples based on 3 replicates (10 tillers \ replicate) – 10 double sweeps were made

**Figure 5: Population density of *Ch. carnea* during the two successive seasons of 2023/24 and 2024/25.**

1.3.4 The population density of *Aphidius* sp:

The population density of *Aphidius* sp individuals on wheat plants during the two studied seasons of 2023/24 and 2024/25 is summarized in Table (7), and graphically demonstrated in Fig. (6). The population of

Aphidius sp was not detected until the 4th week of February (average number of 8.6 individuals) it had one peak at the 4th week of March with an average number of 15 individuals. Then, the numbers decreased till the harvest. In the second season 2024/25, the parasitoid began to appear

in wheat plant plots during the 3rd week of February with an average number of 9.5 individuals, then the number increased to reach

its highest peak at the 4th week of March with a mean number of 26.3 individuals. The numbers decreased gradually till the end of the season.

Table 7: Population density of *Aphidius* sp during the two successive seasons of 2023/24 and 2024/25

Sampling date ^(1,2)	Weekly mean number of individuals	
	Season 2023/24	Season 2024/25
3 rd week of February	0	9.5
4 th	8.67	14.5
1 st week of March	7	5.5
2 nd	7.5	13.5
3 rd	8	8
4 th	15	26.3
1 st week of April	4	1.5
2 nd	0	0
3 rd	0	0
4 th	0	2
General Mean	5.01	8.08

(1) Weekly counts based on two counts every 3-4 days

(2) Samples based on 3 replicates (10 tillers \ replicate) – 10 double sweeps were made.

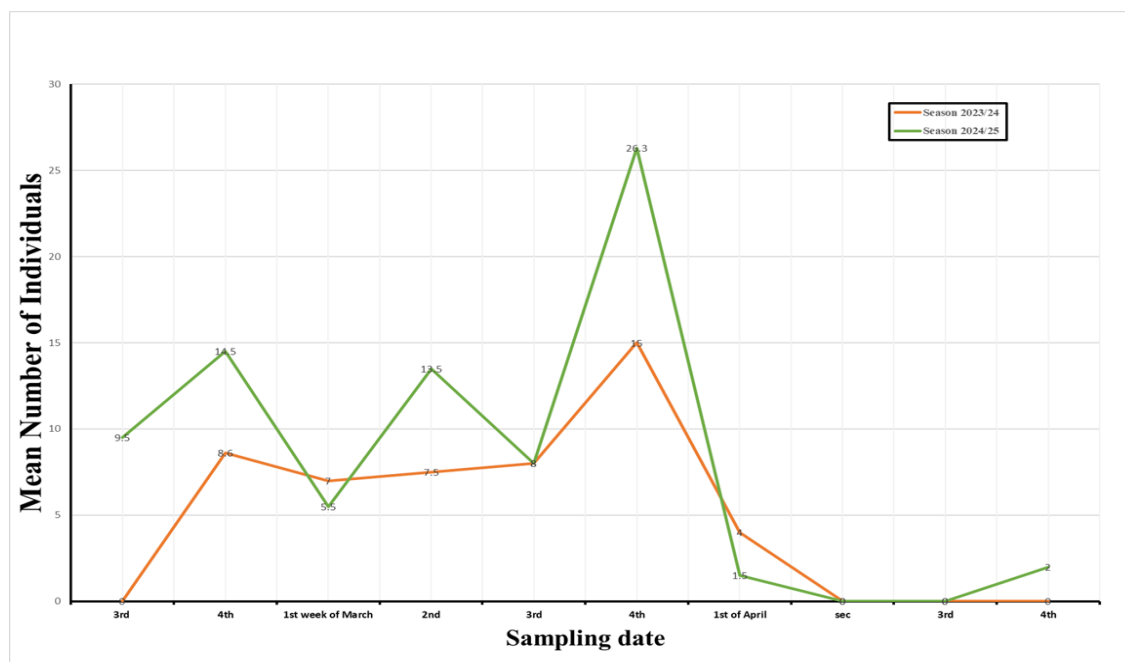


Figure 6 : Population density of *Aphidius* sp during the two successive seasons of 2023/24 and 2024/25.

To determine the differences between the pests and their natural enemies' populations. The population of *R. padi* was higher in the second

season than the first season, but the difference was not statistically significant (T-test, $p = 0.0965$).

Similarly, *S. graminum* showed slightly low numbers in the second season as compared with the first season with no significant difference (T-test, $p = 0.3118$).

Among all the natural enemies, *C. undecimpunctata* showed a significant increase in the second season compared to the first season (T-test, $p = 0.0027$). also in the same trend, *Metasyrphus corollae* populations were significantly higher in the second season compared to the first (T-test, $p = 0.0112$). The same trend was also found with *Aphidius* sp. populations which was significantly higher in the second season as compared with the first (T-test, $p = 0.0464$).

Generally, the results revealed that the presence of three aphid species which infested wheat plants, *R. padi*, *S. graminum*, and *S. avenae*. as the main cereal aphid species in Minia Region. The data agree with those obtained by **Tantawi et al. (1986)**, **Samad (2004)**, **Sobhy et al. (2004)**, **Slman (2006)**, **Adly et al. (2006)**, **Shehata et al. (2018)**, **El-Dessouki et al. (2022)**. **El-Heneidy (1994)** and **Bakry et al. (2024)** found that *R. padi* was the most abundant aphid species in Egypt. **Youssif et al. (2017)** recorded that the maximum population density of cereal aphids on wheat plants occurred during February and March in Sharkia Government. **El-Heneidy (1994)**, **Mansour (2012)**, and **Ahmad et al. (2016)** recorded that *R. padi* in Egyptian wheat fields was the most abundant aphid species in recent years. *R. padi* has become the most frequent aphid species on wheat crops and is abundant throughout all developmental stages of wheat plants.

Also, the obtained data agree with that obtained by **El-Heneidy and Attia (1989)**, **Salem (2002)**,

Abdel-Samad and Gomma (2004) found that natural enemies play an important role in natural regulation of aphid populations in wheat fields. In addition, they stated that the rapid decline in aphids densities by late summer is primarily due to the high rates of predators and parasitoids. The present results are concluded that the natural enemies of cereal aphids affect aphid numbers particularly at the time of their higher population level.

Samad (2004), **El-Heneidy and Rizk (2004)**, **Slman and Ahmed (2005)**, **Slman (2006)** who reported that *C. undecimpunctata* was the most specific aphid predator.

Shehata et al. (2018) estimated a 17% reduction in aphid populations due to the activity of natural enemies in Assiut.

Sobhy et al. (2004) and **Umm-E-Rumman et al. (2024)** observed *Aphidius* sp as dominant parasitoids in resistant wheat cultivars.

CONCLUSION

The present study provides a comprehensive survey of the insect complex associated with wheat plants in Minia region, Minia Governorate, Egypt, during two successive growing seasons of 2023/24 and 2024/25. The findings confirm that cereal aphids, particularly *R. padi*, was the most predominant pest species infesting wheat crops, with seasonal peaks occurring mainly during February and March. In contrast, the populations of *S. graminum* and *S. avenae* were relatively low.

Natural enemies, including the predators *C. undecimpunctata*, *M. corollae*, *Ch. carnea*, and the parasitoid *Aphidius* sp., were consistently associated with aphid populations. Their densities increased markedly in the second season, with statistically significant differences observed for *C. undecimpunctata*, *M. corollae*, and *Aphidius* sp. These findings emphasize the ecological importance of natural enemies in suppressing cereal aphid populations and provide evidence of their adaptation and effectiveness under field conditions.

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الملخص العربي

حصر للحشرات والكثافة العددية للآفات الحشرية الرئيسية والأعداء الحيوية التي تسكن نباتات القمح في منطقة المنيا، المنيا، مصر

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خلال الدراسة تم إجراء حصر حقلي بهدف تحديد الحشرات المصاحبة لنباتات القمح وتقدير الكثافة العددية للآفات الرئيسية وأعدائها الحيوية على محصول القمح في منطقة المنيا خلال موسمي الزراعة ٢٠٢٣/٢٠٢٤ و ٢٠٢٤/٢٠٢٥. أظهرت النتائج تسجيل ٢٠ نوعاً من مفصليات الأرجل تابعة إلى ١٥ فصيلة و ١٠ رتب، من بينها ١٢ نوعاً من الآفات و ٧ مفترسات ونوع واحد من الطفيليات. مثلت أنواع المن (*Sitobion avenae*، *Schizaphis graminum*، *Rhopalosiphum padi*) الآفات الرئيسية، وكان النوع *Rhopalosiphum padi* الأكثر وفرة وانتشاراً. كما تم تسجيل عدد من الأعداء الحيوية التي تساهم في التحكم الطبيعي بهذه الآفات، من أبرزها خنفساء أبو العيد ذو الـ ١٠ نقاط *Coccinella undecimpunctata*، وذبابة السيرفس *Metasyrphus corollae*، والدبور الطفيلي *Aphidius* spp. أظهرت البيانات زيادة ملحوظة في أعداد هذه الأعداء الحيوية خلال الموسم الثاني، مما يشير إلى دورها الفعال في مكافحة الآفات وقدرتها على الحد من كثافة الحشرات الضارة. لم تُظهر فروق معنوية بين موسمي الدراسة في أعداد الآفات، باستثناء بعض الأعداء الحيوية التي لوحظ بها زيادات ملحوظة في كثافتها خلال الموسم الثاني، ما يعزز أهمية إدراجهم في استراتيجيات مكافحة الحيوية المستدامة.

كلمات مفتاحية: القمح، الأعداء الحيوية، حصر حقلي، طفيلي، المنيا