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SEASONAL ABUNDANCE AND RELATIVE DENSITIES OF COCCINELLID SPECIES AND THEIR INSECT PARASITOIDS ON WHEAT PLANTS AT PILBES DISTRICT, SHARKIA GOVERNORATE, EGYPT

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ABSTRACT: Survey and relative densities of coccinellid species and their parasitoids on wheat plants infesting with aphids at Pilbes district, Sharkia Governorate, Egypt was studied during 2015/16-2016/17 seasons. Summarized results show the following: Seven predaceous species belonging to family Coccinellidae viz., *Coccinella undecimpunctata* L., *Coccinella septempunctata* L., *Coccinella 9-punctata* L., *Scymnus syriacus* Mars, *Scymnus interruptus* (Goeze), *Cydonia vicina isis* Cr. and *Cydonia vicina nilotica* Muls were surveyed on wheat plants infesting with aphids. The general relative densities of the predators were 33.33, 20.29, 19.44, 12.35, 7.41, 4.01 and 2.47% of the total numbers of predators, respectively. *C. undecimpunctata* activity showed a distinct peak and two peaks of activity in the first and second seasons, respectively. The maximum total monthly counts of 83 and 77 predators were found during March, in the first and second seasons. Five species of hymenopterous parasitoids belong to three families were emerged from collected ladybeetles species, viz., *Telenomus* sp., *Perilitus coccinellae* (Schrank), *Tetrastichus coccinellae* Kurd., *Tetrastichus principiae* Domenichini and *Tetrastichus* sp. The egg parasitoid, *Telenomus* sp. came in the first rank, represented by 59.8%, followed by the larval parasitoid *P. coccinellae* 14.6%. The correlations between the total number of coccinellid predators and aphids were positive and highly significant in both seasons.

Key words: Coccinellid species, coccinellid parasitoids, parasitism, wheat plants.

INTRODUCTION

Coccinellidae are considered useful natural enemies feeding on phytophagous insect species and regulating their populations in many agricultural systems involving commercial crops (Obrycki *et al.*, 2009). Many Coccinellidae species are promising predatory biocontrol agents for many phytophagous pests including aphids, scale insects, whiteflies, mites, Jassids, thrips, mealybugs and eggs of various lepidopterous insects (Hodek and Honek, 1996; Omkar and Srivastava, 2003; Silva *et al.*, 2012; Vandereycken *et al.*, 2015). Ladybeetles are commonly found in vegetation containing grasses and herbs, and are predacious in the adult and larval stage (Shehta, 2008). Coccinellidae species known as ladybeetle

such as *Coccinella*, *Cydonia*, *Hippodamia*, *Stethorus*, *Rodalia* (= *Vedalia*), *Scymnus* and *Cryptolaemus* species (Brown, 2004; Zeynep *et al.*, 2011; James *et al.*, 2012). Several coccinellid species were recorded on different fields, vegetable and fruit crops in Egypt.

The aphids, *Aphis craccivora* Koch., *Aphis gossypii* (Glover) and *Myzus persicae* (Sulzer) constitute the food essential for the majority of Coccinellidae (Obreycki *et al.*, 2009). For most agricultural systems, the augmentative releases and conservation techniques for ladybird beetles are greatly emphasized to maximize their uses in biological control (Rizvi *et al.*, 1994). Ladybeetles are tools in various biocontrol strategies worldwide like classical inundative, inoculative and conservative

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strategies (Obreycki and Kring, 1998; Weber and Lundgren, 2009). This family gained an interested role as important group of predators in the biological control of insect pests attacking different crop plants. Many coccinellid species were recorded associated with the pests in fields of different economic crops (Shalaby *et al.*, 2008). Many attempts have been made by releasing some biocontrol agents, particularly common coccinellid species for controlling aphid species. In the fields, eggs, larvae, pupae and adults of coccinellids are attacked by several parasitoids which affected the effectiveness of the ladybird beetles (Keiko *et al.*, 1995; Silva *et al.*, 2012; Trouve *et al.*, 2012; Richerson and Deloach, 2017). The present work aimed to study the following points.

1. Survey and relative densities of coccinellid species.
2. Seasonal abundance of the predominant coccinellid species in relation with prevailing temperatures and relative humidities.
3. Survey, relative densities and seasonal abundance of insect parasitoids associated with that coccinellid species in relation with prevailing temperatures and relative humidities.

MATERIALS AND METHODS

The present investigation was carried out at Bilbes district, Sharkia Governorate, Egypt during two wheat growing seasons of 2015-16 and 2016-17 to survey, relative densities and seasonal abundance of coccinellid species and their insect parasitoids.

The experimental area was about half faddan, was cultivated with wheat, *Triticum aestivum* L., variety Sakha 69 and sown on 10th November during the two seasons. Normal agricultural practices were used in the due time and no chemical control was applied.

To survey, relative densities and seasonal abundance of coccinellid species and their insect parasitoids, ten wheat tillers infested with aphids were collected and kept each in a polyethylene bag, and carefully transferred to the laboratory to be examined under a stereoscopic microscope. Adults and nymphs of aphid were counted. Coccinellid predators in most cases were directly counted and in few

cases laboratory rearing was necessary for the immature stages up to adult emergence to be counted and identified. Eggs of coccinellid predators found on tillers wheat were collected, counted and isolated according to the color, (yellow, brown and black). The un-parasitized eggs, yellow ones, were put singly in plastic vials, 7 x 2 cm, and were observed daily until hatching. Newly hatched larvae were provided daily with aphids until pupation. The parasitized brown and black eggs were placed singly in plastic vials until parasitoids emergence. Some of the parasitoid adults were killed and kept in specimen vials containing 70% ethyl alcohol and glycerin. Larvae of coccinellid predators reared individually in Petri- dishes, 10 cm diameter, on *R. aphids* on *S. graminum* until pupation and emergence of the predators or parasitoids. The parasitoids were collected, counted and preserved in glass vials containing 70% ethyl alcohol and glycerin. The pupae were isolated, then placed individually in clean plastic vials and kept till the emergence of the predators or parasitoids. The parasitoids specimens were mounted in canada balsam on glass slides for identification. The parasitoids were identified in Biological Control Department, Plant Protection Research Institute, ARC, Giza, Egypt with the help of Prof. Dr. Ahmed R. Hamed, Chief of Biological Control Research. Daily records of temperatures and relative humidities during the period of investigation were obtained from Agrometeorological Station in Egypt. Simple correlation coefficient (r), simple regression coefficient (b) was calculated.

Statistical analysis of data was conducted using general linear model (GLM) and regression (Reg.) in SAS (SAS institute).

RESULTS AND DISCUSSION

Survey and Relative Densities of Coccinellid Species Associated with Aphids Infesting Wheat Plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016-2017 Seasons

Results presented in Table 1 show that several Coccinellid species, belong to family Coccinellidae were surveyed associated with aphids infested wheat plants. The species could be arranged descendingly according to their

Table 1. Survey and relative densities of Coccinellid species associated with aphids infesting wheat plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016-2017 seasons

Family	Species	Season				General		Total ratio of predator : prey		General ratio of predator: prey
		2015-2016		2016-2017		No.	Dom. (%)	2015-2016	2016-2017	
		No.	Dom. (%)	No.	Dom. (%)					
Coccinellidae	<i>C. undecimpunctata</i>	116	29.82	100	38.6	216	33.33	1:18.41	1:16.34	1:17.45
	<i>C. septempunctata</i>	72	18.51	64	24.7	136	20.99	1:29.67	1:25.53	1:27.72
	<i>C. 9-punctata</i>	69	17.74	57	22.0	126	19.44	1:30.96	1:28.67	1:29.92
	<i>S. syriacus</i>	62	15.94	18	6.9	80	12.35	1:34.45	1:90.8	1:47.13
	<i>S. interruptus</i>	37	9.51	11	4.3	48	7.41	1:57.73	1:148.5	1:78.54
	<i>C. vicina isis</i>	20	5.14	6	2.3	26	4.01	1:106.8	1:272.3	1:145
	<i>C. vicina nilotica</i>	13	3.34	3	1.2	16	2.47	1:164.31	1:544.7	1:235.63
General total		389	100	259	100	648	100	1:5.49	1:6.31	1:5.81

Dom. = Dominance

dominance percentages in the two seasons of study as follows: *Coccinella undecimpunctata* L., *Coccinella septempunctata* L., *Coccinella 9-punctata* L., *Scymnus syriacus* Mars., *Scymnus interruptus* (Goeze), *Cydonia vicina isis* Cr. and *Cydonia vicina nilotica* Muls., with general dominance, 33.33, 20.99, 19.44, 12.35, 7.41, 4.01 and 2.47% of the total count of Coccinellid species, respectively.

According the predator: prey ratio, *C. undecimpunctata* recorded the highest ratio (1:18.41 and 1:16.34) in the two seasons with general ratio (1:17.45) and *C. vicina nilotica* had the lowest one (1:164.31 and 1:544.7) with general ratio (1:235.63), respectively. Total predator: prey ratio was 1:5.49 and 1:6.31 in the 2015/2016 and 2016/2017 seasons, respectively with general ratio of 1:5.81.

The presented results are in agreement with the findings of Vandereycken *et al.* (2015) who surveyed seven aphidophagous ladybirds viz., *C. undecimpunctata*, *C. septempunctata*, *Coccinella quinquepunctata* L., *Harmonia axyridis* Pallas, *Hippodamia undecimnotata* Schneider, *H. variegata* Goeze and *Propylea quatuordecimpunctata* L. on aphids, infesting wheat plants.

Also Ahmed *et al.* (2016) found that *Coccinella* sp. was recorded associated with aphids on wheat plants.

Youssif *et al.* (2017) in Egypt, recorded six preadaceous insect species belonging to four orders and five families associated with aphid species infesting wheat plants.

Among all recorded preadaceous species, *C. undecimpunctata* and *C. septempunctata* were the most dominant species, comprised 15.68 and 15.26% of the total count of the predators, respectively.

Youssif (2019) in Egypt recorded seven species of Coccinellid predators on aphids infesting pear trees.

Seasonal Abundance of Coccinellid Species

C. undecimpunctata

Results given in Table 2 reveal that in the first season, the first record of *C. undecimpunctata* at 4th week of 30 individuals. Three weeks late after the first appearance of the aphids, 386 individuals/sample, at means of 19.5°C and 51.0% RH. The predator population showed a distinct peak of 33 individuals/304 aphids in the 1st week of March at means of 22.4°C and 49.5% RH.

Table 2. Seasonal abundance of Coccinellid species associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2015 - 2016 season

Weekly date of sample	Number of aphid (10 samples)	Number of coccinellid species							Predators : prey	Corresponding means of		
		<i>C. undecimpunctata</i>	<i>C. septempunctata</i>	<i>C. 9-punctata</i>	<i>S. syriacus</i>	<i>S. interruptus</i>	<i>C. vicina isis</i>	<i>C. vicina nilotica</i>		Total number	Temp. °C	RH (%)
Feb., 1st (2016)	44	0	0	0	0	0	0	0	0	0:44.0	13.0	67.5
2nd	135	0	0	0	0	0	0	0	0	0:135.0	14.9	57.2
3rd	240	0	0	0	0	0	0	0	0	0:240.0	20.3	46.4
4th	386	30	10	15	18	10	1	2	86	1:4.49	19.5	51.0
Total	805	30	10	15	18	10	1	2	86	1:9.36		
Mar., 1st	304	33	29	20	15	10	9	5	121	1:2.51	22.4	49.5
2nd	285	23	15	13	12	7	2	1	73	1:3.90	20.5	48.7
3rd	250	15	13	10	10	5	2	3	58	1:4.31	21.8	43.0
4th	192	8	2	7	3	3	4	1	28	1:6.86	20.0	47.7
5th	145	4	1	2	2	1	1	1	12	1:12.08	21.6	43.8
Total	1176	83	60	52	42	26	18	11	292	1:4.03		
Apr., 1st	110	2	1	1	1	1	1	0	7	1:15.71	22.7	53.7
2nd	45	1	1	1	1	0	0	0	4	1:11.25	26.4	40.7
Total	155	3	2	2	2	1	1	0	11	1:14.09		
General total	2136	116	72	69	62	37	20	13	389			

The highest total monthly numbers of *C. undecimpunctata* was 83 ladybeetle/1176 aphids, that was found during March, while and the lowest count, three predators/155 aphids was recorded during April.

As shown from the obtained results in Table 3, in the second season, the predator occurred from the 3rd week of February till the 2nd week of April. During this period, the predator population showed two peaks of activity. The first one, 14 ladybeetle/214 aphids, took place in the 4th week of February at means of 18.5°C and 59.3% RH. The second and the highest peak with 22 ladybeetle/237 aphids occurred in the 3rd week of March at means of 19.2°C and 62.1% RH.

The predator population showed the highest total monthly of 77 ladybeetles/1053 aphids

during March, while only two ladybeetles /69 aphids was recorded during April.

Mohamed *et al.* (2000) found that the most consistently abundant predators associated with the Russian wheat aphid *D. noxia* was the Coccinellid species. **Abd El-Megid *et al.* (2007)** stated that the maximum monthly total count of *C. undecimpunctata* was recorded during April. Mean while, the lowest value, one individual, was obtained during February. The mean of predator: prey ratio during the season was 1: 30.77. **Youssif *et al.* (2017)** added that the population of *C. undecimpunctata* was detected from the 4th week of January till the 4th week of April. Generally the predator population was fluctuated, showing three peaks in 3rd week of February, 1st week of March and 2nd week of April.

Table 3. Seasonal abundance of Coccinellid species associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2016 - 2017 season

Weekly date of sample	Number of aphid (10 samples)	Number of coccinellid species							Predators : prey	Corresponding means of		
		<i>C. undecimpunctata</i>	<i>C. septempunctata</i>	<i>C. 9-punctata</i>	<i>S. syriacus</i>	<i>S. interruptus</i>	<i>C. vicina isis</i>	<i>C. vicina nilotica</i>		Total number	Temp. °C	RH (%)
Feb., 1 st (2017)	32	0	0	0	0	0	0	0	0	0:32.0	18.5	59.3
2 nd	81	0	0	0	0	0	0	0	0	0:81.0	15.3	63.3
3 rd	185	7	3	2	1	1	0	0	14	0:13.21	16.3	63.7
4 th	214	14	10	5	2	1	1	0	33	0:6.48	18.5	59.3
Total	512	21	13	7	3	2	1	0	47	0:10.89		
Mar., 1 st	289	12	3	9	1	1	1	1	28	1:13.14	21.3	58.2
2 nd	265	18	8	10	0	2	1	1	40	1:8.28	19.9	63.3
3 rd	237	22	22	14	5	2	1	1	67	1:3.25	19.2	62.1
4 th	164	18	12	5	7	3	1	0	46	1:3.28	18.3	60.3
5 th	98	7	5	12	0	1	1	0	26	1:3.27	19.3	62.0
Total	1053	77	50	50	13	9	5	3	207	1:5.09		
Apr., 1 st	54	1	1	0	1	0	0	0	3	1:18.00	20.3	59.2
2 nd	15	1	0	0	1	0	0	0	2	1:7.5	20.0	53.9
Total	69	2	1	0	2	0	0	0	5	1:13.8		
General total	1634	100	64	57	18	11	6	3	259			

C. septempunctata

In the first season, results given in Table 2 indicate that the predator was detected from the 4th week of February till the 2nd week of April. During this period, *C. septempunctata* population showed one peak, 29 ladybeetles/304 aphids in the 1st week of March at means of 22.4°C and 49.5% RH. The maximum monthly total number, 60 ladybeetles/1176 aphids, occurred during March and the lowest one, two ladybeetles/155 aphids was recorded during April. The predator:prey ratio during the first season, results obtained in Table 1 was 1:29.67. In the second season results obtained in Table 3 reveal that the first record of the predator, three individuals/ sample, started two weeks late after the first appearance of the aphids, 185 individuals/ sample, in the 3rd week

of February at means of 16.3°C and 63.7% RH. Then, the predator population was increased to reach its highest peak of 22 ladybeetles in the 3rd week of March at means of 19.2°C and 62.1% RH. The maximum total monthly numbers, 50 ladybeetles/ 1053 aphids, occurred during March and the lowest one recorded one ladybeetles/69 aphids, were obtained during April. The mean ratio of predator: aphids during the season was 1:25.53.

Sajioqi *et al.* (2009) recorded the highest number of *C. septempunctata* during the 3rd week of March. The population of the predator started decline with the decrease in aphid population and in the last week of April the lowest population of the predator was recorded. Youssif *et al.* (2017) stated that the predator was detected through the period from the 1st

week of January to the 2nd week of April, showed two peaks of activity, the first one of 12 predators was in the 2nd week of February. The second and highest peak of 15 predators took place in the 1st week of March.

C. 9-punctata

As shown from the obtained results in Table 2, the first appearance of the predator in the first season with 15 ladybeetles/386 aphids was in the 4th week of February, three week late after the first record of the aphids. Thereafter, the predator was recorded in all samples recorded one peak of 20 ladybeetles/304 aphids in the 1st week of March at means of 22.4°C and 49.5% RH. Thereafter, the predator number was decreased gradually. The maximum total monthly number, 52 ladybeetles/1176 aphids, was obtained during March, while only two ladybeetles /155 aphids was recorded during April. Results given in Table 3 reveal that in the second season *C. 9-punctata* occurred from the 3rd week of February till the 5th week of March. During this period, the predator population showed two peaks of activity. The first one, 14 ladybeetles/237 aphids, took place in the 3rd week of March at means of 19.2°C and 62.1% RH. The second peak with 12 ladybeetles/98 aphids, occurred in the 5th week of March at means of 19.3°C and 62.0% RH. The mean ratio of predator to aphid was not detected during April. The highest total monthly number, 50 ladybeetles/1053 aphids was recorded during March, and the lowest one, seven ladybeetles/512 aphids was obtained during February.

James *et al.* (2012) reported that the highest number of *C. 9-punctata* was recorded in April and May in open field infesting with aphids.

Seasonal abundance of the total number of Coccinellid species

In the first season, the results presented in Table 2 reveal that the Coccinellidae predators were detected from the 4th week of February till the 2nd week of April, with the exception of the 1st, 2nd and 3rd week of February. The total number of Coccinellid species showed one peak of activity, 121 predators/ 304 aphids was observed in the 1st week of March at means of 22.4°C and 49.5% RH. Thereafter, the total

number of predators decreased gradually to record its minimum value, four individuals/45 aphids in the 2nd week of April at means of 26.4°C and 40.7% RH. The highest total monthly number of 292 predators/1176 aphids was recorded during March, while the lowest value, 11 predators/155 aphids was noticed during April. The mean of predator: prey ratio during the whole season was 1:5.49.

In the second season, the results obtained in Table 3 reveal that the Coccinellid species was detected during the period from the 3rd week of February till the 2nd week of April. The total number of predators appeared two peaks during the season. The first and lowest peak, 33 ladybeetles /214 aphids, occurred in the 4th week of February at means of 18.5°C and 59.3% RH. The second and the highest peak with the total number of 67 ladybeetles /237 aphids, took place in the 3rd week of March at means of 19.2°C and 62.1% RH. The maximum total monthly number of 207 ladybeetles/1053 aphids, was obtained during March, while the minimum one, five ladybeetles/69 aphids was noticed during April. The predator : prey ratio during the season was 1:6.31.

Statistical analysis indicated that there were positive correlations and highly significant between aphids and predators count during the two successive seasons, whereas (r) values were 0.814** and 0.748** during the first and second seasons, respectively.

Youssif *et al.* (2017) in Egypt indicated that the initial aphids infestation was recorded in the 2nd week of January, while the first record of the Coccinellid species two individuals was in the 2nd week of January, the population of predators fluctuated showed three peaks. The total recorded predators showed that means of 1:61.62 and 1:118.73 predators : prey ratios in the first and second seasons, respectively.

Survey and relative densities of Coccinellid parasitoids

Results given in Table 4 reveal that five species of hymenopterous parasitoids belong to three families were recorded. One egg parasitoid species, (*Telenomus* sp., Scelionidae.) was emerged from collected eggs of Coccinellid

Table 4. Survey and relative densities of parasitoids emerged from different immature stages of Coccinellid associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016-2017 seasons

Specie	Family	2015-2016			2016-2017			General		
		No. (parasitoid/predator)	Total parasitism (%)	Dom. (%)	No. (parasitoid/predator)	Total parasitism (%)	Dom. (%)	No. (parasitoid/predator)	Parasitism (%)	Dom. (%)
Eggs parasitoid,										
<i>Telenomus</i> sp.	Scelionidae	32/301	10.63	56.14	17/209	8.13	68	49/510	9.61	59.8
Larval parasitoid,										
<i>Perilitus coccinellae</i> (Schrank)	Braconidae	9/54	16.67	15.79	3/25	12.00	12	12/79	15.19	14.6
Pupal parasitoids,										
<i>Tetrastichus coccinellae</i> Kurd	Eulophidae	9/34	26.47	15.79	2/25	8.00	8	11/59	18.64	13.4
<i>Tetrastichus principiae</i> Domenichini	Eulophidae	5/34	14.71	8.77	2/25	8.00	8	7/59	11.86	8.5
<i>Tetrastichus</i> sp.	Eulophidae	2/34	5.88	3.51	1/25	4.00	4	3/59	5.08	3.7
General total		57/389	14.65	100	25/259	9.65	100	82/648	12.65	100

species. One larval parasitoid (*Perilitus coccinellae* (Schrank), Braconidae) and three pupal parasitoids namely *Tetrastichu coccinellae* Kurd, *Tetrastichus principiae* Domenichini and *Tetrastichus* sp. belong to family Eulophidae were emerged from collected Coccinellid species.

In the first season the pupal parasitoid, *T. coccinellae* came in the first rank, represented by total parasitism percentage of 26.47% and in the second one larval parasitoid *T. principiae* had the highest percentage, 12%. Concerning the general parasitism percentage during the two seasons, the pupal parasitoid, *T. coccinellae* recorded the highest persenteg, 18.64%.

The general total parasitism percentages of coccinellid species were 14.66 and 9.65% in the first and second seasons, consecutively.

The parasitoids could be arranged descendingly according to their general dominance percentages during the two seasons of study as follow:

Telenomus sp., *P. coccinellae*, *T. coccinellae*, *T. principiae* and *Tetrastichus* sp. by 59.8, 14.6, 13.4, 8.5 and 3.7% of the total collected parasitoids, respectively.

The present results are in agreement with those of **Keiko *et al.* (1995)** who mentioned that *P. coccinellae* is a parasitoid of *C. septempunctata* on pear trees infesting with aphids. **Youssif (2019)** in Egypt, recorded five species of hymenopterous parasitoids attack egg parasitoid *Telenomus*, larvae parasitoid *Perilitus coccinellae* and pupae parasitoid *Tetrastichus coccinellae*, *Tetrastichus principiae* of Coccinellid species.

Seasonal Abundance of Coccinellid Parasitoids

Egg parasitoid, *Telenomus* sp.

Results presented in Table 5 indicate that in the first season, the endo parasitoid, *Telenomus* sp. parasitized Coccinellid eggs during the period extended from the 2nd week of March till the 2nd week of April. The parasitism percentages indicated two peaks. The first peak, 14.52% was recorded in the 2nd week of March at means of 20.5°C and 48.7% RH. The second one of 71.43%, took place in the 4th week of March at means of 21.6°C and 43.8% RH. The maximal and minimal monthly means of parasitism percentages were detected during March and April, with 16.67 and 13.03%, respectively. In the second season, *Telenomus* sp.

Table 5. Seasonal abundance of egg Coccinellid parasitoid, *Telenomus* sp. and parasitism percentages on Coccinellid Species associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016- 2017 seasons

Weekly date of sample	Number of				Egg		Corresponding means of			
	Collected eggs		Emerged parasitoids		parasitism (%)		Temp. (°C)		RH (%)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Feb., 1st	0	0	0	0	0.00	0.00	13.0	18.5	67.5	59.3
2nd	0	0	0	0	0.00	0.00	14.9	15.3	57.2	63.3
3rd	0	10	0	0	0.00	0.00	20.3	16.3	46.4	63.7
4th	57	23	0	1	0.00	4.35	19.5	18.5	51.0	59.3
Total	57	33	0	1	0.00	3.03				
Mar., 1st	93	15	0	1	0.00	6.67	22.4	21.3	49.5	58.2
2nd	62	28	9	0	14.52	0.00	20.5	19.9	48.7	63.3
3rd	53	65	5	1	9.43	1.54	21.8	19.2	43.0	62.1
4th	23	43	12	8	52.17	18.60	20.0	18.3	47.7	60.3
5th	7	22	5	5	71.43	22.73	21.6	19.3	43.8	62.0
Total	238	173	31	15	13.03	8.67				
Apr., 1st	4	2	1	1	25	50	22.7	20.3	53.7	59.2
2nd	2	1	0	0	0.00	0.00	26.4	20.0	40.7	53.9
Total	6	3	1	1	16.67	33.33				
General total	301	209	32	17	10.63	8.13				

parasitized Coccinellid eggs during the period from 4th week of February till the first week of April except in the 2nd week of March.

The parasitoid indicated two peaks, the first and lowest one, of 6.67% parasitism was obtained in the 4th week of February at means of 22.4°C and 49.5% RH. The second and highest one, 22.73% parasitism took place in the 5th week of March at means of 19.3°C and 62.0% RH. The highest and lowest monthly means of parasitism percentages were found during March and February with 8.67 and 3.03%, respectively. In general, *Telenomus* sp. showed general total of 10.63 and 8.13% parasitism in the first and second seasons, respectively.

Youssif (2019) stated that the *Telenomus* sp. in an egg parasitoids parasitized Coccinellid eggs.

Larval parasitoid, *P. coccinellae*

P. coccinellae was recorded as solitary endo larval parasitoid attack Coccinellid larvae, then, the parasitoid emerged from the 4th larval instar of predator. As shown in Table 6 in the first season, *P. coccinellae* occurred from the 4th week of March till the 1st week of April. During this period, the parasitism percentages showed one peak, 40.0%, took place in the 4th week of March at means of 20.0°C and 47.7% RH. No individuals of this parasitoid were detected during February. The highest monthly mean of parasitism percentages 21.21% was recorded

Table 6. Seasonal abundance of larval Coccinellid parasitoid, *P. coccinellae* and parasitism percentages on Coccinellid Species associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016- 2017 seasons

Weekly date of sample	Number of				Larval		Corresponding means of			
	Collected larvae		Emerg ed parasitoid		parasitism (%)		Temp. (°C)		RH (%)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Feb., 1 st	0	0	0	0	0.00	0.00	13.0	18.5	67.5	59.3
2 nd	0	0	0	0	0.00	0.00	14.9	15.3	57.2	63.3
3 rd	0	0	0	0	0.00	0.00	20.3	16.3	46.4	63.7
4 th	0	0	0	0	0.00	0.00	19.5	18.5	51.0	59.3
Total	0	0	0	0	0.00	0.00				
Mar., 1 st	0	0	0	0	0.00	0.00	22.4	21.3	49.5	58.2
2 nd	1	0	0	0	0.00	0.00	20.5	19.9	48.7	63.3
3 rd	11	0	0	0	0.00	0.00	21.8	19.2	43.0	62.1
4 th	5	2	2	1	40.0	50.0	20.0	18.3	47.7	60.3
5 th	16	8	5	1	31.25	12.5	21.6	19.3	43.8	62.0
Total	33	10	7	2	21.21	20.0				
Apr., 1 st	13	10	2	1	15.38	10	22.7	20.3	53.7	59.2
2 nd	8	5	0	0	0.00	0.00	26.4	20.0	40.7	53.9
Total	21	15	2	1	9.52	6.67				
General total	54	25	9	3	16.67	12.00				

during March, while the lowest value, 9.52% was found during April. Similar trend was obtained in the second season, where as the parasitoid was found from the 4th week of March to the 1st week of April. The parasitoid showed one peak, 50.0%, was obtained in the 4th week of March at means of 18.3°C and 60.3% RH. Number of parasitism could be detected during February. The highest monthly mean of parasitism percentages 20.0%, was recorded during March, while the lowest value, 6.67% was found during April. Generally, larval parasitoid *P. coccinellae* indicated general total percentages of 16.67 and 12.00% parasitism in the first and second seasons, respectively.

Keiko et al. (1995) mentioned that *P. coccinellae* is a parasitoid of *C. septempunctata*. **Richerson and Deloach (2017)** reported that the parasitoid

P. coccinellae attack *Coccinella* sp. associated with aphids infesting vegetable crops.

Pupal parasitoid, *T. principiae*

Results presented in Table 7 show the fluctuations of pupal parasitoid, *T. principiae* on Coccinellid species associated with aphids infested wheat plants and parasitism (%) during the two seasons of study.

In the first season, the parasitism percentages showed three peaks. The first one, 33.33% parasitism occurred in the 3rd week of March at means of 20.5°C and 48.7% RH. The second one, 28.57% took place in the 5th week of March at means of 21.6°C and 43.8% RH. The third and highest peak, 50.0% was recorded in the 1st week of April at means of 22.7°C and 53.7% RH. Number of pupal parasitoid was detected

Table 7. Seasonal abundance of pupal Coccinellid parasitoid, *T. principae* and parasitism percentages on Coccinellid Species associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016- 2017 seasons.

Weekly date of sample	Number of				Pupal		Corresponding means of			
	Collected pupa		Emerged parasitoid		parasitism (%)		Temp. (°C)		RH (%)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Feb., 1st	0	0	0	0	0.00	0.00	13.0	18.5	67.5	59.3
2nd	0	0	0	0	0.00	0.00	14.9	15.3	57.2	63.3
3rd	1	0	0	0	0.00	0.00	20.3	16.3	46.4	63.7
4th	0	4	0	1	0.00	25.0	19.5	18.5	51.0	59.3
Total	1	4	0	1	0.00	25.0				
Mar., 1st	3	5	0	0	0.00	0.00	22.4	21.3	49.5	58.2
2nd	3	5	1	0	33.3	0.00	20.5	19.9	48.7	63.3
3rd	9	2	3	1	33.3	50.0	21.8	19.2	43.0	62.1
4th	9	4	2	0	22.22	0.00	20.0	18.3	47.7	60.3
5th	7	4	2	0	28.57	0.00	21.6	19.3	43.8	62.0
Total	31	20	8	1	25.81	5.0				
Apr., 1st	2	0	1	0	50.0	0.00	22.7	20.3	53.7	59.2
2nd	0	1	0	0	0.00	0.00	26.4	20.0	40.7	53.9
Total	2	1	1	0	50.0	0.00				
General total	34	25	9	2	26.47	8.00				

during February. The maximum and minimum monthly means of parasitism percentages, 50.0 and 25.81%, occurred in April and March, respectively.

In the second season, the results given in Table 7 show that the parasitism by pupal parasitoid indicated two peaks. The first peak, 25.0% was recorded in the 4th week of February at means of 18.5°C and 59.3% RH. The second and the highest one, 50.0% took place in the 3rd week of March at means of 19.2°C and 62.1% RH. Number of pupal parasitoid was detected during April. The highest and lowest monthly means of parasitism percentages, 50.0 and 25.0% were recorded during March and February, respectively. The general total percentages of parasitism by pupal parasitoids were 26.47 and 8.00% in the first and second seasons, respectively.

Gautam (1994) reported that the grubs and pupae of *C. septempunctata* were found parasitized by an eulophid *T. coccinellae* in vegetable crops infesting with aphids. **El-Gepaly et al. (2018)** added that *T. coccinellae* was the most dominant parasitoid reared from pupae of *C. undecimpunctata* associated with aphid. Also, the *T. coccinellae* is a gregarious, endoparasitoids attack pupal stage of *C. undecimpunctata* associated with aphids in vegetables crops.

Total percentages of parasitism

Results represented in Table 8 show the fluctuations of the total number of Coccinellids different immature stages parasitoids and total parasitism percentages of coccinellid species associated with aphids infesting wheat plants during the two seasons of study. The total

Table 8. Seasonal abundance of Coccinellids different immature stages parasitoids and total percentages of parasitism on Coccinellid species associated with aphid infesting wheat plants in Belbis District, Sharkia Governorate during 2015-2016 and 2016- 2017 seasons

Weekly date of sample	Total number of				Total		Corresponding means of			
	Collected different immature stages of Coccinellid species		Emerged parasitoids		parasitism (%)		Temp. (°C)		RH (%)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Feb., 1st	0	0	0	0	0.00	0.00	13.0	18.5	67.5	59.3
2nd	0	0	0	0	0.00	0.00	14.9	15.3	57.2	63.3
3rd	1	10	0	0	0.00	0.00	20.3	16.3	46.4	63.7
4th	57	27	0	3	0.00	11.11	19.5	18.5	51.0	59.3
Total	58	37	0	3	0.00	8.11				
Mar., 1st	96	20	0	2	0.00	10.0	22.4	21.3	49.5	58.2
2nd	66	33	10	0	15.15	0.00	20.5	19.9	48.7	63.3
3rd	73	67	10	2	13.7	2.99	21.8	19.2	43.0	62.1
4th	37	49	18	10	48.65	20.41	20.0	18.3	47.7	60.3
5th	30	34	14	6	46.67	17.65	21.6	19.3	43.8	62.0
Total	302	203	52	20	17.22	9.85				
Apr., 1st	19	12	5	2	26.32	16.67	22.7	20.3	53.7	59.2
2nd	10	7	0	0	0.00	0.00	26.4	20.0	40.7	53.9
Total	29	19	5	2	17.24	10.53				
General total	389	259	57	25	14.66	9.65				

parasitism percentages showed one peak in the 4th week of March with 48.65% and 20.41% in the tow seasons of study, respectively. Also the total number of emerged parasitoids recorded one peak at the same date by 18 and 10 parasitoids in the first and second seasons, respectively. The corresponding means of temperatures at these peaks were 20.0 and 18.3°C associated with 47.7% and 60.3% RH in the tow seasons, respectively. The general percentages of parasitism during these seasons were 14.66% and 9.65%, respectively.

Statistical analysis indicated that there were positive and highly significant correlations between weekly numbers of the aphid and numbers of coccinellid predators in the two

seasons of study. The correlations between the total number of coccinellid predators and parasitoids were negative in the first season ($r = -0.0666$) and ($r = 0.462$) positive in the second one, being insignificant in both seasons.

Conclusion

The present work was conducted to study the seasonal abundance of coccinellid species and their insect parasitoids on wheat plants infested with aphids during two successive seasons 2015-2016 and 2016-2017. Seven predaceous species belonging to family Coccinellidae viz., *C. undecimpunctata*, *C. septempunctata*, *C. 9-punctata*, *S. syriacus*, *S. interruptus*, *C. vicina isis* and *C. vicina*

nilotica were surveyed. The general relative densities of the predators were 33.33, 20.99, 19.44, 12.35, 7.41, 4.01 and 2.47% of the total number of predators, respectively. The highest total monthly counts of 292 predators, was obtained during March, followed by 86 predators during February in the first season. Five species of hymenopterous parasitoids belong to three families were emerged from collected coccinellid individuals. One egg parasitoid, *Telenomus* sp. belong to family Scelionidae. One larval parasitoid belong to family Braconidae. Three pupal parasitoids namely *T. coccinellae*, *T. principiae* and *Tetrastichus* sp. belong to family Eulophidae. The pupal parasitoid, *T. coccinellae* came in the first rank, represented by total parasitism 26.47% in the first season and larval parasitoid *T. principiae* was in the second one by 12%.

The general total parasitism percentages of coccinellid species were 14.66 and 9.65% in the first and second seasons, consecutively.

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الوفرة الموسمية والكثافة النسبية لأنواع أبي العيد وطفيلياتها الحشرية على نباتات القمح بمركز بلبس - محافظة الشرقية - مصر

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تم دراسة الوفرة الموسمية والكثافة النسبية لأنواع أبي العيد وطفيليات الحشرية المصاحبة لها على نباتات القمح المصابة بالمن خلال موسم الدراسة ٢٠١٥/٢٠١٦ و ٢٠١٦/٢٠١٧ م بمنطقة بلبس، محافظة الشرقية، مصر، وقد أوضحت النتائج الآتي: سجل سبعة أنواع من المفترسات الحشرية تنتمي لعائلة أبي العيد هم: *Coccinella undecimpunctata* L., *Coccinella septempunctata* L., *Coccinella 9-punctata* L., *Scymnus syriacus* Mars, *Scymnus interruptus* (Goeze), *Cydonia vicina isis* Cr. and *Cydonia vicina nilotica* Muls على نباتات القمح المصابة بالمن، حيث كانت الكثافة النسبية العامة لمفترسات أبي العيد هي: ٣٣،٣٣، ٢٠،٢٩، ١٩،٤٤، ١٢،٣٥، ٧،٤١، ٤،٠١ و ٢،٤٧% من العدد الكلي للمفترسات، على التوالي، أظهر نشاط أبي العيد ذو الإحدى عشر نقطة ذروة وذروتين في الموسمين الأول والثاني، على التوالي، تم حصر خمسة أنواع من الطفيليات غشائية الأجنحة تنتمي إلى ثلاث عائلات وهم: *Telenomus* sp., *Perilitus coccinellae* (Schrank)، *Tetrastichus coccinellae* Kurd., *Tetrastichus principiae* Domenichini and *Tetrastichus* sp طفيل البيض *Telenomus* sp. يقع في المرتبة الأولى بنسبة تواجد ٥٩،٨% يليه الطفيل اليرقي *Perilitus coccinellae* (Schrank) بنسبة ١٤،٦%، أظهر التحليل الإحصائي وجود علاقة موجبة ومعنوية جدا بين كل من العدد الكلي للمفترسات والعدد الكلي للمن خلال موسم الدراسة.

المحكمون:

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