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APHIDOPHAGOUS SYRPHID PREDATORS AND THEIR PARASITOIDS ON MAIZE PLANTS

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ABSTRACT: Survey and population densities of aphidophagous syrphid predators and their insect hyperparasitoids on maize plants infesting with aphids namely, *Rhopalosiphum maidis* (Fitch) and *Rhopalosiphum padi* (Linnaeus) at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt were studied during 2022 and 2023 seasons. The obtained results were summarized as follow: six species of aphidophagous syrphid belonging to family Syrphidae namely, *Xanthogramma aegyptium* Wied., *Sphaerophoria flavicauda* Zett., *Paragus aegyptius* Macq., *Paragus* spp., *Metasyrphus* (=Syrphus) *corollae* (Fabr.) and *Scaeva albomaculata* Macq were surveyed on maize plants infesting with aphids. The total relative densities of the syrphid species were 34.17, 23.92, 18.54, 10.36, 7.22 and 5.79 % of the total number of hoverfly, successively. The total numbers of aphidophagous syrphid predators were fluctuated, showing a distinct peaks of 343 and 371 predators/sample in the 2nd and 3rd weeks of August during the first and second seasons, consecutively. The highest total monthly counts of 1016 and 1299 predators recorded in August during two successive seasons 2022 and 2023, consecutively. The means of syrphids : prey ratio were 1 : 28.76 and 1 : 22.59 during two successive seasons. Five species of hyperparasitoids belong to four families were recorded parasitized on syrphid species namely, *Telenomus acrobats* Giard, *Telenomus* sp. (Scelionidae), *Diplazon laetatorius* (Fabricius) (Ichneumonidae), *Syrphophagus aphidivorus* (Mayr) (Encyrtidae) and *Tetrastichus* sp. (Eulophidae), represented 25.43, 16.38, 25.43, 19.62 and 13.14% of the total collected hyperparasitoids, successively. The fluctuations of the total parasitoidism percentages recorded one and two peaks of activity during the first and second seasons, respectively. The mean percentages of parasitoidism during the second season was relatively low, 17.65 % in comparison with that in the first one (21.67%). The correlations between the total numbers of aphidophagous syrphid species and percentages of parasitoidism were positive significant during two successive seasons. The periodic mean temperature and relative humidity affected syrphid species population by 55.27 and 62.57% during the 1st and 2nd seasons, respectively. Temperature and relative humidity affected percentages of parasitoidism by 51.19 and 47.34 during the 1st and 2nd seasons, consecutively. Generally, the pesticides are not the only ones that affect on aphidophagous syrphid predators but the hyperparasitoids decrease the total numbers of the predators and negatively or harmfully affect their role in the biological control of aphid species in open felids and greenhouses.

Key words: Aphidophagous syrphid predators, parasitoidism, Syrphid hyperparasitoids, biological control, maize plants

INTRODUCTION

The hoverflies (Diptera: Syrphidae) are known as important biological control agents of hemipterans in agricultural ecosystems. Aphidophagous syrphid predators are one of the most important

factors decreasing the number of aphids infesting maize plants (Larson *et al.*, 2001; Youssif *et al.*, 2021). Syrphid species are predacious in the larval stages, while mean, the adult syrphids are also of ecological importance as they feed on nectar and pollen and play a role

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in the pollination of several crops or mixed garden plantings infested with aphids (Moldenke, 1975). Aphidophagous syrphid predators are essential pollinators of flowering plants in several environments worldwide. Syrphid fly adults are frequent flower visitors to a wide range of wild plants, as well as agricultural crops, and are often considered the second-most important group of pollinators after wild bees (Larson *et al.*, 2001). Syrphid fly larvae are voracious predator of white flies, aphids, mites, scale insects, thrips, psyllids, mealybugs, Jassids and eggs of various lepidopterous insects (Weems, 1954; Schneider, 1969; Youssif *et al.*, 2021).

Several dipteran aphidophagous predator, mainly corresponding family Syrphidae used in controlling insect pests through the syrphid flies. Syrphidae predators, namely, *Xanthogramma*, *Sphaerophoria*, *Paragus*, *Metasyrphus*, *Scaeva*, *Episyrphus*, *Eupeodes*, *Allograpta* and *Toxomerus* (Youssif *et al.*, 2017; Youssif *et al.*, 2021). The aphids, *Aphis gossypii* (Glover), *Aphis craccivora* Koch, *Shizaphis graminum* (Rondani), *Rhopalosiphum maidis* (Fitch), *Rhopalosiphum padi* (Linnaeus), *Macrosiphum avenae* (Fabricius) and *Myzus persicae* (Sülzer) constitute the food necessary for the majority of syrphid predators (Sharma and Metha, 2021).

Many applied experiments based on rearing and mass production of syrphid species on natural hosts and artificial diets and its release in open fields and greenhouses. For controlling aphids, which have achieved great success in reducing the aphid population with the aim of rationalizing the use of pesticides and obtaining safe and healthy food free of pesticide residues (Li and Wu, 2023).

Aphidophagous syrphid predators or hoverflies are attacked by different species of hymenopterous parasitoids, common being Pteromalidae, Ichneumonidae, Encyrtidae, Megasplidae, Scelionidae, Figitidae and Eulophidae (Scott, 1939; Evenhuis, 1966; Dusek *et al.*, 1979; Rotheray, 1979; Fitton and Rotheray, 1982; Dean, 1983; Radeva, 1983; Thirion, 1987; Fitton and Boston, 1988; Abbas *et al.*, 2016; Ali *et al.*, 2013).

Hyperparasitoids decrease the total numbers of syrphid predators and negatively or harmfully

affect their role in the biological control of aphids in greenhouses and open fields (Khoramabadi *et al.*, 2016). In the open fields, the immature stages of the syrphid predators (eggs, larvae and pupae) are parasitized by numerous hyperparasitoids which influenced on the efficiency of hoverflies (Sommaggio *et al.*, 2013; Diazlucas *et al.*, 2020; Wanasinghe *et al.*, 2022).

The aim of the study was to identify the hyperparasitoids of aphidophagous syrphid predators and cleared their role in the decrease of the hoverflies population associated with aphids infesting maize plants.

The aim of study as follows:

- 1-Survey and population densities of aphidophagous syrphid predators.
- 2-Seasonal population of the aphidophagous syrphid predators corresponding with temperatures and relative humidities.
- 3-Survey, relative densities and seasonal population of hyperparasitoids related with aphidophagous syrphid predators corresponding with temperatures and relative humidities.

MATERIALS AND METHODS

The present experiments were conducted at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during the two respective maize growing seasons, 2022 and 2023. Experimental area was about half feddan, cultivated with maize, *Zea mays* L., Tribile hybrid 310 (T.C.310) in the first week of June during 2022 and 2023 seasons. The normal agricultural practices were adapted in the due time without any insecticidal application. To study the survey, population densities of aphidophagous syrphid predators and hyperparasitoids associated with hoverflies or syrphid species on maize plants, 15 tassels of maize infested with aphids were weekly selected at random, picked up, placed in paper bags, and transferred into laboratory, where carefully examined by the aid of stereoscopic microscope. The number of aphids were counted. Immature stages of aphidophagous syrphid rearing in laboratory till emergence of the syrphid adults to be counted and classified.

Hoverflies egg or syrphid species mentioned on tassels of maize plants were harvested,

counted and insulated according to color of eggs, (white, creamy, brown and dark brown). Unparasitized eggs, (white color) were transferred gently from the tassels of maize plants, using a fine brush, and placed separately in test tubes (15 x 1 cm), closed with cotton wool and reserved under laboratory conditions till hatching or emergence of hyperparasitoids. The parasitized eggs brown or black of syrphid predators were transferred singly to test tubes as previously described till emergence of hyperparasitoids. The percentages of parasitism for syrphid eggs were calculated. The adults of the hyperparasitoids were killed and saved in vials glass containing, glycerin and 70 % ethyl alcohol. Syrphid larvae were reared separately or individually on tassels of maize plants infesting with aphids in glass vials (6.5x3.5 cm), covered with pieces of muslin set in their positions by means of rubber bands, until pupation and emergence of syrphid species or hyperparasitoids. Larval-pupal hyperparasitoids were calculated and put in glass vials containing glycerin and 70% ethyl alcohol. The percentages of parasitism for the syrphid larvae were counted. Pupae of syrphid were insulated and reserved separately in glass vials as previously described till emergence of the syrphid predators or hyperparasitoids. The hyperparasitoids were fixed on glass slides in canada balsam for identification. Temperatures and relative humidities were obtained from the meteorological Station in Abou-Kbeer district, Sharkia Governorate. Correlation coefficient (r), regression coefficient (b) and explained variance (E.V.) were calculated.

Analysis of data was performed using general linear model (GLM) and regression (Reg.) in SAS (SAS institute) (1998).

RESULTS AND DISCUSSION

Survey, Population Densities and Seasonal Abundance of Aphidophagous Syrphid Associated with Aphids Infesting Maize Plants

Survey and relative densities of aphidophagous syrphid predators

Data in Table 1 and Plate 1 revealed that several syrphid predators belong to one family Syrphidae were found associated with aphids, namely *Rhopalosiphum maidis* (Fitch) and *Rhopalosiphum padi* (Linnaeus) infesting maize plants. Six species of syrphid predators were surveyed, the syrphid species could be organized descendingly according to their general relative densities during the two respective seasons as follows: *Xanthogramma aegyptium* Wied., *Sphaerophoria flavicauda* Zett., *Paragus aegyptius* Macq., *Paragus* spp., *Metasyrphus* (=Syrphus) *corollae* (Fabr.) and *Scaeva albomaculata* Macq with 34.17, 23.92, 18.54, 10.36, 7.22 and 5.79% of the entier number of hoverfly, successively. The maximum relative density of syrphid species correlated with species of aphid infesting maize plants was *Xanthogramma aegyptium* (31.21 and 36.47 %), respectively during 2022 and 2023 seasons.

Table 1. Survey and population densities of aphidophagous syrphid species associated with aphids infesting maize plants at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Family	Syrphid species	2022		2023		General	
		No.	%	No.	%	No.	%
Syrphidae	<i>Xanthogramma aegyptium</i> Wied.	412	31.21	620	36.47	1032	34.17
	<i>Sphaerophoria flavicauda</i> Zett.	377	28.56	345	20.29	722	23.92
	<i>Paragus aegyptius</i> Macq.	250	18.94	310	18.24	560	18.54
	<i>Paragus</i> spp.	121	9.17	192	11.29	313	10.36
	<i>Metasyrphus</i> (=Syrphus) <i>corollae</i> (Fabr.)	88	6.67	130	7.65	218	7.22
	<i>Scaeva albomaculata</i> Macq .	72	5.45	103	6.06	175	5.79
General total		1320		1700		3020	
	%		100.0		100.0		100.0

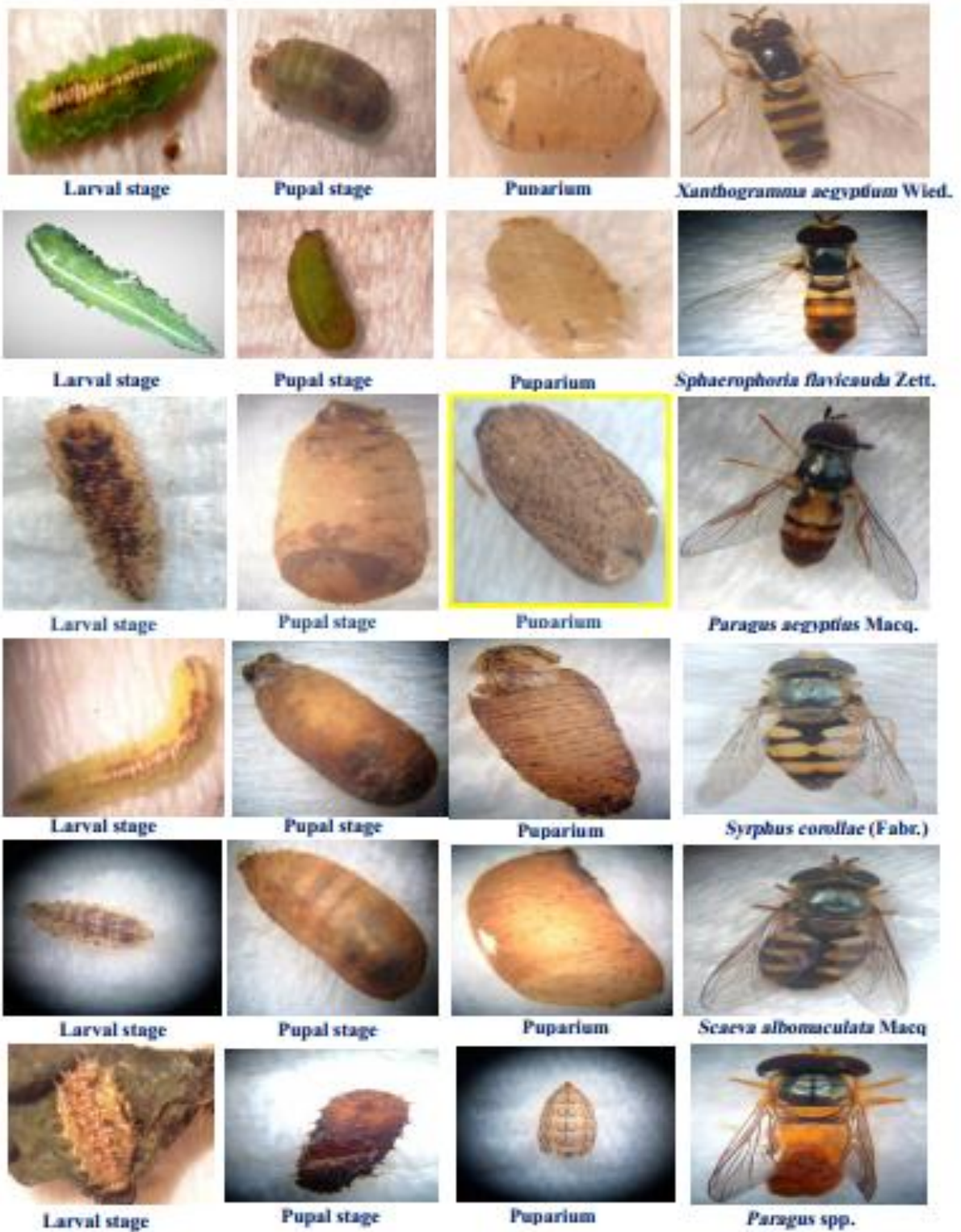


Plate 1. Different aphidophagous syrphid species associated with aphids infesting maize plants

Abd El-Megid *et al.* (2007) who recorded three species of hoverflies as predaceous species associated with aphids infesting maize plants. They were *M. corollae*, *X. aegyptium* and *P. aegyptius*. *M. corollae* ranked the first category, represented 28.71 and 23.44% of all recorded syrphids in the first and second seasons, successively.

These results are disagreement with those of Krawczyk *et al.* (2011) recorded four species of aphidophagous syrphid, *Sphaerophoria scripta* (L.), *Sphaerophoria rueppelli* (Wied.), *Sphaerophoria menthastri* (L.) and *Episyrphus balteatus* (Deg.) were found on maize plants infesting with aphid species, with general relative densities of 11.73, 53.3, 26.7 and 20.0%, of the entire number of syrphid species, successively.

These results are similar with the findings of Khoramabadi *et al.* (2016) recorded two species of aphidophagous syrphids, *Eupeodes corolla* Fabricius and *Scaeva albomaculata* Macq. associated with aphids.

These results are in agreement with the findings of El-Husseini *et al.* (2018) recorded three species of aphidophagous syrphid, viz., *S. flavicauda*, *P. aegyptius* and *S. corolla* predacious of aphids infesting of maize plants.

Seasonal abundance of aphidophagous syrphids predators

Seasonal population of *Xanthogramma aegyptium* Wied.

As clearly shown from the obtained data in Tables 2 and 3, in the first and second seasons of study (2022 and 2023), *X. aegyptium* noticed from the 3rd week of July till the 5th week of September, through this period, the syrphid population was fluctuated, recording two activity peaks during two successive season. The highest peak of activity records (155 predators / 4200 aphids) and (167 syrphids / 11321 aphids) in the 3rd week of August at means of (29.8 °C. and 61.3% RH.) and (32.0 °C. and 64.2% RH.) during the 1st and 2nd seasons, successively. The mean ratio of syrphid : aphid during the whole seasons was 1:92.13 comparing to 1:61.94 for the first one.

Obtained results are in agreement with El-Baz (2007) stated that the occurrence of syrphid aphidophagous, *X. aegyptium* began after the

occurrence of the aphids infestation, three weeks later with seven aphids, two peaks of abundance could be detected in the fourth week of August with 27 hoverflies / 59050 aphids / sample and nine syrphids / 6000 aphids in the 2nd week of September. The total monthly count recorded its maximum (42 syrphids) during August.

Seasonal abundance of *Sphaerophoria flavicauda* Zett.

In the first season (2022), in Table 2, the first occurrence of the larval stage of the aphidophagous insect predator, *S. flavicauda* was noticed in the 4th week of July and synchronized with aphid infestation with 12 individuals predator/185 aphids/15 tasseles) at means of 30.3°C and 57.3% RH. *S. flavicauda* number increased reaching its peak of activity (89 specimens in the 3rd week of August/ 4200 aphids/15 tasseles at weather factors means 29.8°C and 61.3% RH. The 2nd peak, 62 predators at the 1st week of September could be detected/13110 aphids /sample at 29.9°C and 60.9% RH. The number of the hoverfly, *S. flavicauda* decreased gradually at the end of the season. The highly total monthly count (279) was found in August. The seasonal syrphid : aphid ratio during this season estimated with 1 : 100 :68 .

In the 2nd season (2023) of cultivation, the syrphid, *S. flavicauda* was detected on aphids infested maize plants through the period from 3rd week of July to the last week of September, 2023. Seasonal population of the predator fluctuated and showed two peaks of activity (Table 3). These peaks of abundance were recorded in the 1st and 4th weeks of August with the respective values 77 and 63 syrphids / 1352 and 9318 aphids /15 tasseles at 31.8 and 30.0°C & 64.2 and 63.8% RH., successively. The maximum monthly total count have the same trend as in the 1st season where the maximum value recorded during August (245 predators). The value of predator: prey during the whole seasons was 1:10 :12 comparing to 1 : 111.31 for the first one.

Jasiolek *et al.* (1997) who reported that the syrphid, *Sphaerophoria* sp. was the most dominant hoverfly predaceous of aphids infesting of maize plants.

Table 2. Seasonal abundance of aphidophagous syrphid predators associated with aphids infesting maize plants at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 season.

Date sample	Number of aphids/ sample	No. of syrphid species							Total numbers	Predators : prey	Corresponding means of	
		<i>X. aegyptium</i>	<i>S. flavicauda</i>	<i>P. aegyptius</i>	<i>Paragus</i> spp	<i>M. corollae</i>	<i>S. albomaculata</i>	Temp. °C			% RH	
Jul.,	3 rd	163	2	0	0	0	0	0	2	1:81.50	29.1	55.5
	4 th	185	13	12	29	0	0	0	54	1:3.43	30.3	57.3
Total		348	15	12	29	0	0	0	56	1:6.21		
Aug.,	1 st	300	55	77	56	18	25	15	246	1:1.22	31.1	63.5
	2 nd	2150	115	56	29	20	33	10	263	1:8.17	31.5	62.3
	3 rd	4200	155	89	33	39	12	15	343	1:12.24	29.8	61.3
	4 th	10120	11	57	56	18	11	11	164	1:61.71	30.2	61.1
Total		16770	336	279	174	95	81	51	1016	1:16.51		
Sep.,	1 st	13110	25	62	23	14	5	17	146	1:89.79	29.9	60.9
	2 nd	4113	13	8	14	12	2	3	52	1:79.10	30.7	60.5
	3 rd	2133	10	9	10	0	0	1	30	1:71.10	29.7	60.7
	4 th	1033	8	6	0	0	0	0	14	1:73.79	27.5	60.9
	5 th	450	5	1	0	0	0	0	6	1:75.00	26.9	60.3
Total		20839	61	86	47	26	7	21	248	1:84.03		
General total		37957	412	377	250	121	88	72	1320			
General mean of predator : prey ratio		3450.64	1:92.13	1:100.68	1:151.83	1:313.69	1:431.33	1:527.18		1:28.76		

Table 3. Seasonal abundance of aphidophagous syrphid species associated with aphids infesting maize plants at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2023 season

Date sample	Number of aphids/ sample	No. of syrphid species							Total numbers	Predators : prey	Corresponding means of	
		<i>X. aegyptium</i>	<i>S. flavicauda</i>	<i>P. aegyptius</i>	<i>Paragus</i> spp	<i>M. corollae</i>	<i>S. albomaculata</i>	Temp. °C			% RH	
Jul.,	3 rd	677	2	1	0	0	0	0	3	1:225.67	30.2	62.8
	4 th	735	32	11	17	0	0	1	61	1:12.05	30.1	63.5
Total		1412	34	12	17	0	0	1	64	1:22.06		
Aug.,	1 st	1352	100	77	66	18	20	10	291	1:4.65	31.8	64.2
	2 nd	3117	122	56	52	62	59	20	371	1:8.40	30.1	65.6
	3 rd	11321	167	49	49	51	25	24	365	1:31.02	32.0	64.2
	4 th	9318	77	63	58	35	18	21	272	1:34.26	30.0	63.8
Total		25108	466	245	225	166	122	75	1299	1:19.33		
Sep.,	1 st	7269	85	35	30	14	5	13	182	1:39.94	30.1	60.9
	2 nd	2931	13	34	22	12	2	12	95	1:30.85	29.9	61.5
	3 rd	937	10	12	11	0	1	2	36	1:26.03	29.5	62.1
	4 th	531	8	6	5	0	0	0	19	1:27.95	28.2	62.0
	5 th	213	4	1	0	0	0	0	5	1:42.60	27.6	62.1
Total		11881	120	88	68	26	8	27	337	1:35.26		
General total		38401	620	345	310	192	130	103	1700	1:22.59		
General mean of predator : prey ratio		3491	1:61.94	1:111.31	1:123.87	1:200.00	1:295.39	1:372.83		1:22.59		

Seasonal abundance of *Paragus aegyptius* Macq

Results presented in Tables 2 and 3 showed that in the 1st and 2nd seasons of cultivation, the occurrence of this syrphid aphidophagous predator began after the occurrence of the aphids infestation, one week later in the 1st and 2nd seasons of study with 29 and 17 predator in the 4th week of July, respectively. The seasonal abundance of *P. aegyptius* during the two successive seasons (2022 and 2023) on aphids infesting maize plants showed two activity peaks. The 1st peak could be detected in the 1st week of August with (56 predators/300 aphids/ sample at 31.1°C and 63.5% RH) and (66 predators/ 1352 aphids / 20 tassels with means of 31.8°C and 64.2% RH. in the 1st and 2nd seasons, respectively. The second peak was found in the 4th week of August by (56 individuals/10120 aphids at means of 30.2°C and 61.1% RH.) and (58 syrphids / 9318 aphids at means of 30.0°C and 63.8 % RH. during two successive seasons 2022 and 2023, respectively. The highest total monthly number of the predator was relatively high in August, recording (225 predators) in the second season as compared with the first one (174 predators). The mean of *P. aegyptius*: aphids during the first and second seasons were 1: 151: 83 and 1: 123:87, successively. Obtained results are in agreement with of **El-Baz (2007)** reported that the seasonal abundance of the syrphid, *P. aegyptius* on maize plant infesting with aphids showed two peaks were recorded during the third week of August and first week of September with 42 and 15 syrphids, respectively.

Total Numbers of Aphidophagous Syrphid Predators

Data presented in Table 2, revealed that the syrphid species occurred during the whole season of 2022, showing one peak of activity. This peak 343 syrphids/4200 aphids was noticed in the 3rd week of August at means of 29.8°C and 61.3% RH. Thereafter, the syrphid predators densities decreased to record its lowest value, six specimens/450 aphids in the 5th week of September at means of 26.9°C and 60.3% RH. The maximum total monthly count of 1016 predators/16770 aphids during August. The mean of predators: prey during the entire season was 1 : 28.76.

In the 2nd season, the data presented in Table 3, show that the syrphid predators were found all – around the season. The total number of syrphids was fluctuated, showing a prominent peak of 371 predators/3117 aphids/sample in the 2nd week of August at means of 30.1°C and 65.6% RH. The maximum and minimum monthly total numbers of the syrphids were noticed during August and September, with numbers of 1299 and 337 predators, consecutively. The mean of syrphids: prey ratio during the whole season was 1 : 22. 59.

These results are in harmony with the findings of **Abd El-Megid et al. (2007)** reported that the first record of syrphids started with three predators/ sample in the fourth week of July, one week later after appearance of aphids infestation, the seasonal abundance of the syrphids showed two peaks of activity. The first peak found in the third week of August with count of 388 syrphids / 70455 aphids, synchronized with the peak of aphids. The maximum total monthly count 254 hoverflies/67510 aphids was found during August followed by 11 syrphids/34695 aphids in September and only three syrphids/163 aphids in July.

These results are in accordance with those of **Sharma and Metha (2021)** stated that the highest peak of activity of the aphidophagous hoverfly recorded during the 4th week of September in maize fields infesting with aphids.

Analysis of data in Table 4 stated that there were positive and insignificant correlations between number of aphids/week and means of both temperature and relative humidity in 2022 and 2023 seasons ($r=0.212$ and 0.523), successively. Relative humidity coefficient values were insignificant ($r= 0.239$ and 0.404) during the 1st and 2nd seasons, successively. The periodic mean temperature (°C) and relative humidity (RH%) affected weekly mean number of the aphids by 41.87 and 50.28% during the 1st and 2nd seasons, respectively.

Analysis of data in Table 5 cleared a positive insignificant and significant correlation between mean temperature and the whole numbers of syrphid species during the 1st and 2nd seasons ($r= 0.590$ and 0.683^*), respectively. Relative humidity had a positive significant ($r=0.609^*$ and 0.705^*) during the 1st and 2nd seasons, successively. The mean temperature (°C) and relative humidity (RH %) influenced syrphid species population by 55.27 and 62.57% in the 1st and 2nd seasons, consecutively.

Table 4. Simple correlation (r), simple regression (b) and explained variance (E.V.) for the weekly mean numbers of aphids / maize plants under the periodic mean temperature (°C) and relative humidity (RH%) at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Season	Considered climatic factors	Values of Simple correlation (r)	Values of simple regression (b)	explained variance (E.V.)%
2022	Number of aphid and periodic mean temp.	0.212	6.890	20.50
	Number of aphid and periodic mean RH%.	0.239	1.216	10.20
	Interaction Temp. x RH			11.17
	Total E.V.			41.87
2023	Number of aphid and periodic mean temp.	0.523	1.797	22.90
	Number of aphid and periodic mean RH%.	0.404	1.487	15.40
	Interaction Temp. x RH			11.98
	Total E.V.			50.28

Table 5. Simple correlation (r), simple regression (b) and explained variance (E.V.) for the total numbers of *Aphidophagous syrphid* species under the periodic mean temperature (°C) and relative humidity (RH %) at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Seasons	Considered climatic factors	Values of Simple correlation (r)	Values of simple regression (b)	explained variance (E.V.)%
2022	Number of aphid and periodic mean temp.	0.590	0.007	22.24
	Number of aphid and periodic mean RH%.	0.609*	0.011	18.15
	Interaction Temp. x RH			14.88
	Total E.V.			55.27
2023	Number of aphid and periodic mean temp.	0.683*	0.006	25.21
	Number of aphid and periodic mean RH%.	0.705*	0.007	20.11
	Interaction Temp. x RH			17.25
	Total E.V.			62.57

*= Significant

Survey and Relative Densities of Syrphid Hyperparasitoids

Data presented in Table 6 and Plate 2 show that five species of hyperparasitoids belonging to four families were recorded during two successive seasons of study. The hyperparasitoids namely, *Telenomus acrobats* Giard, *Telenomus* sp. (Scelionidae), *Diplazon laetatorius* (Fabricius) (Ichneumonidae), *Syrphophagus aphidivorus* (Mayr) (Encyrtidae) and *Tetrastichus* sp. (Eulophidae), represented 25.43, 16.38, 25.43, 19.62 and 13.14% of the total collected hyperparasitoids, successively. *T. acrobats* and *Telenomus* sp. were egg parasitoids, while *D. laetatorius* is larval – pupal parasitoid, while the other species are pupal parasitoids.

Desai and Patel (2001) who reported that the syrphid, *I. scutellaris* was parasitized by three species of hyperparasitoids namely *Syrphophagus* spp., *D. orientalis* and *Callaspidia rufithorax* in maize fields.

These results are partially agreement with the finding of **Jankowska (2004)** who recorded four species of hymenopterous parasitoids, *Diplazon laetatorius* (Fabricius), *Diplazen* sp., *Pachyneuron grande* (Thoms.) and *Syrphophagus aeruginosus* (Dalm.) parasitized on larvae and pupae of syrphid species associated with the aphids infesting maize plants.

Kholer et al. (2008) recorded four species of hyperparasitoids viz., *Syrphoctonus pallipes* (Gravenhorst), *Woldstedius flavolineatus* (Gravenhorst), *Syrphophagus* sp. and *Pachyneuron albutius* Walker were reared from syrphid species associated with aphids infesting different crops.

Mayadunnage et al. (2009) reported that the larvae and pupae of aphidophagous syrphid parasitized by three hyperparasitoids viz., *D. orientalis*, *D. laetatorius* and *Syrphophagus* sp. with relative densities 50.00, 42.30 and 6.30%, respectively.

These results are disagreement with those of **Krawczyk et al. (2011)** who stated that the pupae of aphidophagous syrphid species were found parasitized by four species of hymenopterous parasitoids, *P. grande*, *S. aeruginosus*, *Aphidencyrus aphidivorus* (Mayr) and *Dendrocercus pupparum* (Graham) represented 39.09, 12.78, 25.56 and 22.56 % of the total collected hyperparasitoids, successively.

Sommaggio et al. (2013) recorded *Diplazon* sp. and *Pachyneuron* sp. are hyperparasitoids of the hoverflies, species associated with aphids infesting maize plants. The parasitoid *Diplazon* sp. is one of the most important hyperparasitoid recorded on the larvae of syrphids with relative density (80.0%) of the total hyperparasitoids.

Table 6. Survey and relative densities of aphidophagous syrphid species hyperparasitoids on maize plants infesting with aphids during 2022 and 2023 seasons at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt

Parasitoid species	Family	2022		2023		General	
		No.	%	No.	%	No.	%
Egg hyperparasitoids							
<i>Telenomus acrobates</i> Giard	Scelionidae	68	23.78	81	27.00	149	25.43
<i>Telenomus</i> sp.		44	15.38	52	17.33	96	16.38
Larval - Pupal hyperparasitoids							
<i>Diplazon laetatorius</i> (Fabricius)	Ichneumonidae	81	28.32	68	22.67	149	25.43
Pupal hyperparasitoids							
<i>Syrphophagus aphidivorus</i> (Mayr)	Encyrtidae	61	21.33	54	18.00	115	19.62
<i>Tetrastichus</i> sp.	Eulophidae	32	11.19	45	15.00	77	13.14
Total		286	100.00	300	100.00	586	100.00



Adult stage of *Telenomus acrobates* Giard



Adult stage of *Telenomus* sp. as Solitary egg parasitoid



Adult stage of *Diplazon laetatorius* (Fabricius) as solitary larval pupal parasitoid



Hole of hyperparasitoid adult emergence from syrphid pupae



Adult of *Syrphophagous aphidivorus* (Mayr) as gregarious pupal parasitoid.



Hole of hyperparasitoid adult emergence from syrphid pupae



Adult stage of *Tetrastichus* sp. as gregarious pupal parasitoid.



Hole of hyperparasitoid adult emergence from syrphid pupae



Un parasitized pupa

Plate 2. Hyperparasitoids of syrphid species

These results are similar with the findings of **Khoramabadi et al. (2016)** recorded three species of hyperparasitoids parasitized on the larvae of syrphid flies namely, *D. laetatorius*, *Enizemum ornatum* Gravenhorst and *Pachyneuron formosum* Walker with relative densities 45.00, 14.02 and 1.83%, successively.

Diazlucas et al. (2020) who recorded two hyperparasitoids namely, *D. laetatorius* and *Pachyneuron affnelsoni* parasitized on aphidophagus hoverfly, *Xanthogramma* sp. The parasitoidism rate ranged between 8 and 100% parasitism.

Parasitism Percentages of Egg Parasitoids

Telenomus acrobates Giard

As shown in Table 7 in the 1st season 2022, the egg parasitoid was noticed from the 1st week of August till the 1st week of September, the parasitism percentages increased gradually reaching its peak of activity (33.33%) in the 4th week of August at means of 30.2°C and 61.1% RH. The highest and lowest monthly means of parasitism percentages were found during August and September 17.22 and 7.69%, successively. In the 2nd season of 2023, data given in Table 7 revealed that the *T. acrobats* parasitoid was recorded only in the 1st, 2nd and 3rd weeks of August. The highest mean of the parasitism percentage was recorded during the 2nd week of August with 36.36%, with means of 30.1°C and 65.6% RH. The egg parasitoid *T. acrobats* was not detected during the July and September months.

Generally, *T. acrobats* showed mean percentages of 10.97 and 9.85 % parasitism in the 1st and 2nd seasons, respectively.

Wanasinghe et al. (2022) who mentioned that two species of egg parasitoids, *Telenomus* sp. and *Trichogramma* sp. parasitized on eggs of syrphids and coccinellids associated with aphids.

Telenomus sp.

As shown in Table 8 in the 1st and 2nd seasons, 2022 and 2023, the egg parasitoid, *Telenomus* sp. was not detected during July and September months during two successive seasons. In the first season, the parasitoid showed one peak of activity with 14.39% parasitism with means of 31.5°C and 62.3% RH. In the second season, the egg parasitoid

recorded two peaks, with 16.36 and 9.43% parasitism in the 2nd and 4th weeks of August at means of (30.1°C and 65.6 % RH.) and (30.0° C and 63.8% RH), respectively. In general, the mean percentages of parasitism were 7.10 and 6.33% in the 1st and 2nd seasons, consecutively.

Larval-pupal hyperparasitoid, *Diplazon laetatorius* (Fabricius)

D. laetatorius is one of the most important natural enemies of aphidophagus syrphid flies. The parasitoid was recorded as a solitary larval – pupal parasitoid attacking the larvae of syrphid species until pupation, then the emergence of parasitoid from the syrphid pupae.

In the 1st season (2022), data in Table 9 stated that *D. laetatorius* attacked syrphid larvae during the 1st week of August to 1st week of September with a peak of 22.86% parasitism in the 2nd week of August (31.5°C and 62.3% RH.). Then, it sharply declined to reach its minimal value (9.09%) in the 1st week of September (29.9°C and 60.9% RH). Subsequently, no parasitism was found till 5th week of September. The highest and lowest monthly means of parasitism percentages were recorded during August and September with 16.77 and 8.33 %, respectively. In the 2nd season (2023) the data given in Table 9, the larval-pupal hyperparasitoid, *D. laetatorius* was not detected during July and September months. The Ichneumonidae *D. laetatorius* showed one peak of parasitism (16.28 %) was obtained in the 3rd week of August (32.0°C and 64.2% RH). In generally, *D. laetatorius* showed mean percentages of 16.56 and 14.23% parasitism in the 1st and 2nd seasons, respectively. **Jasiolek et al. (1997)** stated that the hyperparasitoid, *D. laetatorius* as larval – pupal parasitoid caused 25.0 % parasitism of syrphid, *S. flavicauda* in maize fields.

Patal and Dodia (1997) who stated that the hyperparasitoid, *Diplazon orientalis* attack larvae of syrphid, *Ischiodon scutellaris* on different host plants infesting with aphids.

The present results are nearly similar with the findings of **Jankowska (2004)** who reported that the *D. laetatorius* was the most dominant hyperparasitoid reared from larvae of aphidophagous syrphid associated with aphids infesting maize plants, the parasitization by *D. laetatorius* reached 21.70% on the larvae of syrphid species. **Ali et al. (2013)** mentioned that

Table 7. Parasitism percentages on aphidophagous syrphid eggs associated with aphids on maize plants by *Telenomus acrobates* Giard at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Weekly date of samples		No. of				parasitism %		Corresponding means of			
		collected eggs		emerged parasitoids				Temp. °C		% R H	
		2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Jul.,	3 rd	33	54	0	0	0.0	0.0	29.1	30.2	55.5	62.8
	4 th	185	116	0	0	0.0	0.0	30.3	30.1	57.3	63.5
	Total Mean	218	170	0	0	0.0	0.0				
Aug.,	1 st	160	312	18	20	11.25	6.41	31.1	31.8	63.5	64.2
	2 nd	132	110	20	40	15.15	36.36	31.5	30.1	62.3	65.6
	3 rd	55	104	15	21	27.27	20.19	29.8	32.0	61.3	64.2
	4 th	42	53	14	0	33.33	0.0	30.2	30.0	61.1	63.8
	Total Mean	389	579	67	81	17.22	13.99				
Sep.,	1 st	8	44	1	0	12.50	0.0	29.9	30.1	60.9	60.9
	2 nd	5	29	0	0	0.0	0.0	30.7	29.9	60.5	61.5
	3 rd	0	0	0	0	0.0	0.0	29.7	29.5	60.7	62.1
	4 th	0	0	0	0	0.0	0.0	27.5	28.2	60.9	62.0
	5 th	0	0	0	0	0.0	0.0	26.9	27.6	60.3	62.1
	Total Mean	13	73	1	0	7.69	0.0				
	General total	620	822	68	81						
	General mean					10.97	9.85				

Table 8. Parasitism percentages on aphidophagous syrphid eggs associated with aphids on maize plants by *Telenomus* sp. at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons.

Weekly date of samples		No. of				parasitodism %		Corresponding means of			
		collected eggs		emerged parasitoids				Temp. °C		% R H	
		2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Jul.,	3 rd	33	54	0	0	0.0	0.0	29.1	30.2	55.5	62.8
	4 th	185	116	0	0	0.0	0.0	30.3	30.1	57.3	63.5
	Total Mean	218	170	0	0	0.0	0.0				
Aug.,	1 st	160	312	15	21	9.38	6.73	31.1	31.8	63.5	64.2
	2 nd	132	110	19	18	14.39	16.36	31.5	30.1	62.3	65.6
	3 rd	55	104	6	8	10.91	7.69	29.8	32.0	61.3	64.2
	4 th	42	53	4	5	9.52	9.43	30.2	30.0	61.1	63.8
	Total Mean	389	579	44	52	11.31	8.98				
Sep.,	1 st	8	44	0	0	0.0	0.0	29.9	30.1	60.9	60.9
	2 nd	5	29	0	0	0.0	0.0	30.7	29.9	60.5	61.5
	3 rd	0	0	0	0	0.0	0.0	29.7	29.5	60.7	62.1
	4 th	0	0	0	0	0.0	0.0	27.5	28.2	60.9	62.0
	5 th	0	0	0	0	0.0	0.0	26.9	27.6	60.3	62.1
	Total Mean	13	73	0	0	0.0	0.0				
	General total	620	822	44	52						
	General mean					7.10	6.33				

Table 9. Percentages of parasitism on aphidophagous syrphid species larvae associated with aphids on maize plants by *Diplazon laetatorius* (Fabricius) at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons.

Weekly date of samples	Number of				parasitism %		Corresponding means of				
	collected larvae		emerged parasitoids				Temp. °C		% R H		
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	
Jul.,	3 rd	0	0	0	0	0.0	0.0	29.1	30.2	55.5	62.8
	4 th	0	0	0	0	0.0	0.0	30.3	30.1	57.3	63.5
Total Mean		0	0	0	0	0.0	0.0				
Aug.,	1 st	150	59	12	7	8.00	11.86	31.1	31.8	63.5	64.2
	2 nd	210	156	48	25	22.86	16.03	31.5	30.1	62.3	65.6
	3 rd	88	215	15	35	17.05	16.28	29.8	32.0	61.3	64.2
	4 th	29	40	5	1	17.24	2.50	30.2	30.0	61.1	63.8
Total Mean		477	470	80	68	16.77	14.47				
Sep.,	1 st	11	8	1	0	9.09	0.0	29.9	30.1	60.9	60.9
	2 nd	1	0	0	0	0.0	0.0	30.7	29.9	60.5	61.5
	3 rd	0	0	0	0	0.0	0.0	29.7	29.5	60.7	62.1
	4 th	0	0	0	0	0.0	0.0	27.5	28.2	60.9	62.0
	5 th	0	0	0	0	0.0	0.0	26.9	27.6	60.3	62.1
Total Mean		12	8	1	0	8.33	0.0				
General total		489	478	81	68						
General mean						16.56	14.23				

the parasitism of syrphid, *I. scutellaris* larvae by a ichneumonid, *D. laetatorius* occurred in the whole season. The parasitoidism percentages on larvae of this species of syrphid were 19.11 and 24.67% during two successive seasons. These results are disagreement with the findings of **Sommaggio et al. (2013)** who mentioned that the hyperparasitoidism of syrphid species by a Ichneumonid, *Diplazon* sp. occurred during the whole season. The mean percentage of parasitoidism during the whole season (80.0 %).

Pupal Parasitoids

Syrphophagus aphidivorus (Mayr)

The encyrtid hyperparasitoid, *S. aphidivorus* was recorded as gregarious endo- parasitoid attack newly syrphid pupae.

From 211 collected pupae of syrphid species in the 1st season (2022), only 61 pupae were parasitized by pupal parasitoid, *S. aphidivorus* during the whole season, representing 28.91% parasitism, while in the 2nd season (2023) from 400 collected pupae of hoverflies, only 54 pupae were attacked by this parasitoid, representing 13.50 % parasitism (Table 10).

In the 1st season (2022), the parasitism percentages showing two peaks, the first one (32.00%) was recorded in the second week of August with means of 31.5°C and 62.3% RH. The 2nd and highest one, 40.00% took place in the 1st week of September at means of 29.9°C and 60.9% RH.

In the 2nd season (2023), the hyperparasitoids was recorded from the 2nd week of August to the 3rd week of September. Two peaks of parasitism were detected, the 1st one (22.79%) was attained in the third week of August (32.0°C and 64.2% RH) and the 2nd peak (20.00%) was attained in the third week of September at means of 29.5°C and 62.1% RH. No specimens of this parasitoid were noticed during July. The highest and lowest monthly means of parasitism percentages were recorded during August and September with (33.81 and 19.44) % in the first season, and (17.78 and 4.62%) during the 2nd season, respectively. The mean percentage of parasitoidism throughout the 1st season, 28.91 % was obviously higher as compared with that in the 2nd one (13.50 %).

Table 10. Percentages of parasitism on aphidophagous syrphid species pupae associated with aphids on maize plants by *Syrphophagus aphidivorus* (Mayr) at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Weekly date of samples	No. of				parasitism %		Corresponding means of				
	collected pupae		emerged parasitoids				Temp. °C		% R H		
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	
Jul.,	3 rd	0	0	0	0	0.0	0.0	29.1	30.2	55.5	62.8
	4 th	0	0	0	0	0.0	0.0	30.3	30.1	57.3	63.5
Total Mean		0	0	0	0	0.00	0.00				
Aug.,	1 st	0	0	0	0	0.0	0.0	31.1	31.8	63.5	64.2
	2 nd	25	40	8	7	32.00	17.50	31.5	30.1	62.3	65.6
	3 rd	52	136	15	31	28.85	22.79	29.8	32.0	61.3	64.2
	4 th	62	94	24	10	38.71	10.64	30.2	30.0	61.1	63.8
Total Mean		139	270	47	48	33.81	17.78				
Sep.,	1 st	30	62	12	3	40.00	4.84	29.9	30.1	60.9	60.9
	2 nd	22	58	1	2	4.55	3.45	30.7	29.9	60.5	61.5
	3 rd	13	5	1	1	7.69	20.00	29.7	29.5	60.7	62.1
	4 th	6	4	0	0	0.0	0.0	27.5	28.2	60.9	62.0
	5 th	1	1	0	0	0.0	0.0	26.9	27.6	60.3	62.1
Total Mean		72	130	14	6	19.44	4.62				
General total		211	400	61	54						
General mean						28.91	13.50				

Desai and Patel (2001) who reported that the hyperparasitoid, *Syrphophagus* spp. is one of the most important natural enemies of aphidophagous syrphid flies in maize fields.

Tetrastichus sp.

The eulophid parasitoid, *Tetrastichus* sp. was found as gregarious endo-pupal parasitoid parasitized syrphid pupae.

In the 1st and 2nd season (2022 and 2023), data presented in Table 11 stated that the parasitoid, *Tetrastichus* sp. parasitized syrphid pupae during the period from 2nd week of August to the 2nd week of September. The parasitoidism percentages indicated one peak of activity (32.69 and 17.50 %) took place in the 3rd and 2nd weeks of August with means of (29.8°C and 61.3% RH.) and (30.1°C and 65.6% RH.) during the first and second season, respectively. Then, it sharply declined to reach its minimal values (4.55 and 3.45%) in the 2nd week of September during the 1st and 2nd season, respectively. The maximal monthly total counts

were found during August, with 20.86 parasitism in the first season, while 14.82 in the second season. Generally, *Tetrastichus* sp. recorded mean percentages of 15.17 and 11.25 parasitism in the 1st and 2nd seasons, successively.

Total percentages of parasitoidism

Data presented in Table 12 showed that the fluctuations of total parasitoidism percentages of aphidophagous syrphid, including egg, larval-pupal and pupal parasitoids, associated with aphid species infesting maize during two successive seasons of study.

The parasitoids were recorded from the 1st week of August till the third week of September in the 1st and 2nd seasons, In the 1st season 2022, the parasitoidism percentages showed one peak of activity (42.11%) was occurred in the 4th week of August.

The highest monthly mean of parasitoidism percentage, 26.57% was found during August, while the lowest one, 19.59% was obtained during September.

Table 11. Percentages of parasitism on aphidophagous syrphid species pupae on aphids infesting maize plants by *Tetrastichus* sp. at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Weekly date of samples		No. of				parasitism %		Corresponding means of			
		collected pupae		emerged parasitoids				Temp. °C		% R H	
		2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Jul.,	3 rd	0	0	0	0	0.0	0.0	29.1	30.2	55.5	62.8
	4 th	0	0	0	0	0.0	0.0	30.3	30.1	57.3	63.5
	Total Mean	0	0	0	0						
Aug.,	1 st	0	0	0	0	0.0	0.0	31.1	31.8	63.5	64.2
	2 nd	25	40	3	7	12.00	17.50	31.5	30.1	62.3	65.6
	3 rd	52	136	17	23	32.69	16.91	29.8	32.0	61.3	64.2
	4 th	62	94	9	10	14.52	10.64	30.2	30.0	61.1	63.8
	Total Mean	139	270	29	40	20.86	14.82				
Sep.,	1 st	30	62	2	3	6.67	4.84	29.9	30.1	60.9	60.9
	2 nd	22	58	1	2	4.55	3.45	30.7	29.9	60.5	61.5
	3 rd	13	5	0	0	0.0	0.0	29.7	29.5	60.7	62.1
	4 th	6	4	0	0	0.0	0.0	27.5	28.2	60.9	62.0
	5 th	1	1	0	0	0.0	0.0	26.9	27.6	60.3	62.1
	Total Mean	72	130	3	5	4.17	3.85				
	General total	211	400	32	45						
	General mean					15.17	11.25				

Table 12. Total percentages of parasitism on aphidophagous syrphid species on aphids infesting maize plants at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Weekly date of samples		No. of				parasitodism %		Corresponding means of			
		collected of syrphid predators		emerged parasitoids				Temp. °C		% R H	
		2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Jul.,	3 rd	33	54	0	0	0.0	0.0	29.1	30.2	55.5	62.8
	4 th	185	116	0	0	0.0	0.0	30.3	30.1	57.3	63.5
	Total Mean	214	170	0	0	0.00	0.00				
Aug.,	1 st	310	371	45	48	14.52	12.94	31.1	31.8	63.5	64.2
	2 nd	367	306	98	97	26.70	31.70	31.5	30.1	62.3	65.6
	3 rd	195	455	68	118	34.87	25.93	29.8	32.0	61.3	64.2
	4 th	133	187	56	26	42.11	13.90	30.2	30.0	61.1	63.8
	Total Mean	1005	1319	267	289	26.57	21.91				
Sep.,	1 st	49	114	16	6	32.65	5.26	29.9	30.1	60.9	60.9
	2 nd	28	87	2	4	7.14	4.60	30.7	29.9	60.5	61.5
	3 rd	13	5	1	1	7.69	20.0	29.7	29.5	60.7	62.1
	4 th	6	4	0	0	0.0	0.0	27.5	28.2	60.9	62.0
	5 th	1	1	0	0	0.0	0.0	26.9	27.6	60.3	62.1
	Total Mean	97	211	19	11	19.59	5.21				
	General total	1320	1700	286	300						
	General mean					21.67	17.65				

In the 2nd season, 2023, the parasitoidism percentages indicated two peaks. They were in the 2nd week of August and 3rd week of September with 31.70 and 20.00% parasitoidism, successively. The corresponding means of temperatures at these peaks were 30.1 and 29.5°C. in association with 65.6 and 62.1% RH, respectively. The highest monthly mean of parasitoidism percentages, 21.91 was recorded during August, while the lowest one 5.21 % was found during September. The mean percentages of parasitoidism during the 2nd season was relatively low, 17.65 % in comparison with that in the 1st one (21.67%).

Analysis of data in Table 13 stated that there were positive insignificant correlations between percentages of parasitoidism and mean of temperature during two successive seasons. The correlation values between mean of relative humidity and percentage of parasitoidism were positive insignificant and significant, showing ($r = 0.499$ and 0.623^*) in the 1st and 2nd seasons, successively.

The mean temperature (°C) and relative humidity (RH%) affected percentages of parasitoidism by 51.19 and 47.34 during the 1st and 2nd seasons, respectively.

Conclusion

Six species of aphidophagous syrphid belonging to family Syrphidae namely, *Xanthogramma aegyptium* Wied., *Sphaerophoria flavicauda* Zett., *Paragus aegyptius* Macq., *Paragus* spp., *Metasyrphus* (=Syrphus) *corollae* (Fabr.) and *Scaeva albomaculata* Macq were surveyed on maize plants infesting with aphid species. In the open fields, the immature stages of the aphidophagous syrphid predators (eggs, larvae and pupae) are parasitized by numerous hyperparasitoids which affected the efficiency of the hoverflies. Five species of hyperparasitoids belonging to four families were surveyed parasitized on syrphid predators namely, *Telenomus acrobats* Giard, *Telenomus* sp. (Scelionidae), *Diplazon laetatorius* (Fabricius) (Ichneumonidae), *Syrphophagous aphidivorus* (Mayr) (Encyrtidae) and *Tetrastichus* sp. (Eulophidae). Generally, the pesticides are not the only ones that affect on aphidophagous syrphid predators but the hyperparasitoids decrease the total numbers of the predators and negatively or harmfully affect their role in the biological control of aphid species in open felids and greenhouses.

Table 13. Simple correlation (r), simple regression coefficient (b) and explained variance (E.V.) for the parasitoidism percentages of aphidophagous syrphids species, under the periodic mean temperature (°C) and relative humidity (RH %) at El-Deeb village, Abou-Kbeer district, Sharkia Governorate, Egypt during 2022 and 2023 seasons

Seasons	Considered climatic factors	r (Values)	b (Values)	E.V.%
2022	Percentage of parasitoidism and periodic mean temp.	0.469	5.356	25.00
	Percentage of parasitoidism and periodic mean RH%.	0.499	3.640	10.00
	Interaction Temp. x RH			16.19
	Total E.V.			51.19
2023	Percentage of parasitoidism and periodic mean temp.	0.497	4.423	23.41
	Percentage of parasitoidism and periodic mean RH%.	0.623*	5.050	10.37
	Interaction Temp. x RH			13.56
	Total E.V.			47.34

*= Significant

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مفترسات ذباب السرفس وطفيلياتها على نباتات الذرة

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أجريت تلك الدراسة بهدف الحصر والكثافات النسبية لأنواع مفترسات السرفس وطفيلياتها الحشرية على نباتات الذرة الشاميه المصابة بمن *Rhopalosiphum maidis* (Fitch) و *Rhopalosiphum padi* (Linnaeus) خلال موسمى الدراسة 2022 و 2023 بقرية الديب - مركز أبوكبير - محافظة الشرقية - مصر. وقد لخصت النتائج كما يلى: - سجلت ستة أنواع من ذباب السرفس المفترسة للمن تتبع عائلة ذباب السرفس Syrphidae على نباتات الذرة الشاميه المصابة بالمن وهم:- *Xanthogramma aegyptium* Wied., *Sphaerophoria flavicauda* Zett., *Paragus aegyptius* Macq., *Paragus spp.*, *Metasyrphus (=Syrphus) corollae* (Fabr.) و *Scaeva albomaculata* Macq. وبكثافة نسبية عامة 34,17 ، 23,92 ، 18,54 ، 10,36 ، 7,22 ، 5,79% من التعداد الكلى للمفترسات على التوالي. تذبذب التعداد الكلى لمفترس ذباب السرفس موضعا ذروتين (343 و 371 مفترس/عينة) فى الاسبوعين الثانى والثالث من أغسطس خلال الموسم الأول والثانى على التوالي. سجل أعلى تعداد شهرى (1016 و 1299 مفترس) فى أغسطس خلال موسمى الدراسة 2022 و 2023 على الترتيب بلغت نسبة المفترس: المن 1: 28,76 و 1: 22,59 خلال موسمى الدراسة. سجلت خمسة أنواع من الطفيليات الحشرية الغشائية الأجنحة تتبع أربع عائلات متطفلة على أنواع ذباب السرفس Syrphidae هي: *Telenomus acrobats* Giard, *Telenomus sp.* (Scelionidae), *Diplazon laetatorius* (Encyrtidae) *Syrphophagous aphidivorus* (Mayr) (Ichneumonidae) (Fabricius) و *Tetrastichus sp.* (Eulophidae) وبكثافة نسبية عامة 25,43 ، 16,38 ، 25,43 ، 19,62 ، 13,14% من التعداد الكلى للطفيليات الحشرية على الترتيب. سجلت نسب التطفل الكلية ذروة وذروتين للنشاط خلال الموسم الأول والثانى ، على التوالي. كانت متوسط نسب التطفل خلال الموسم الثانى أقل معنويا (17,65%) مقارنة بالموسم الأول (21,67%). كان هناك ارتباط معنوى موجب ما بين التعداد الكلى لذباب السرفس ونسب التطفل خلال موسمى الدراسة المتتاليين. كان تأثير درجة الحرارة والرطوبة النسبية على تعداد مفترسات ذباب السرفس 55,27 و 62,57% فى الموسمين الأول والثانى على التوالي، بينما كان تأثير درجة الحرارة والرطوبة النسبية على نسب التطفل 51,19 و 47,34% فى الموسمين الأول والثانى على الترتيب. وبصفة عامة ليست المبيدات الحشرية هى وحدها التى تؤثر على مفترسات ذباب السرفس لكن الطفيليات الحشرية فائقة التطفل او المفرطه hyperparasitoids تحدث خفض فى التعداد الكلى لمفترسات ذباب السرفس وتؤثر سلبيا على دورها فى برامج المكافحة الحيوية داخل الحقل المكشوف والصوب الزراعية.

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