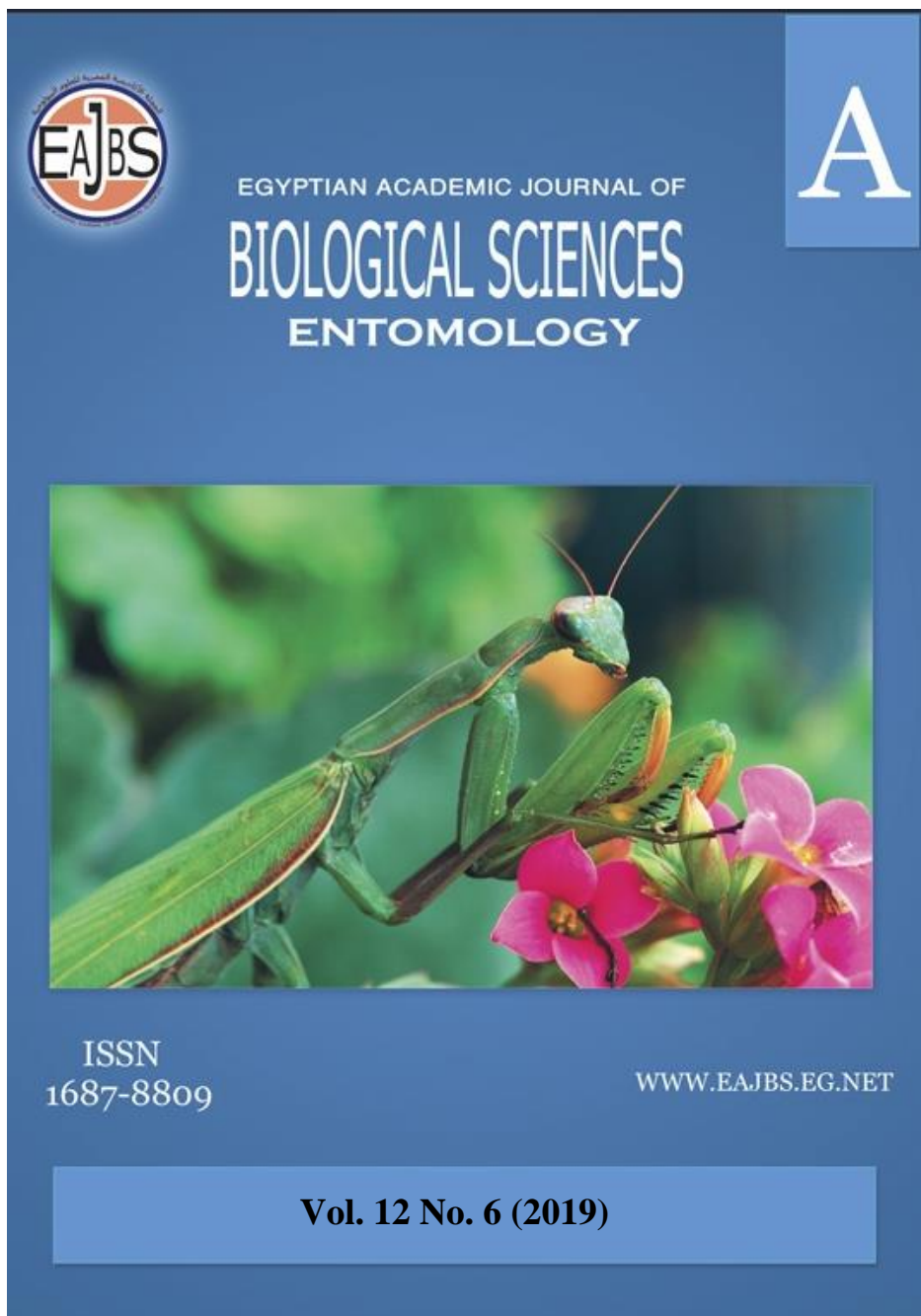
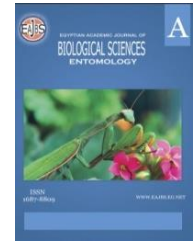


**Provided for non-commercial research and education use.
Not for reproduction, distribution or commercial use.**



Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University. Entomology Journal publishes original research papers and reviews from any entomological discipline or from directly allied fields in ecology, behavioral biology, physiology, biochemistry, development, genetics, systematics, morphology, evolution, control of insects, arachnids, and general entomology.
www.eajbs.eg.net



Field and Biological Laboratory Studies on The Parasitoid, *Psytalia (Opus) concolor* Szépl. (Hymenoptera: Braconidae), Parasitizing the *Zizyphus* Fruit Fly, *Carpomyia incompleta* Becker (Diptera: Tephritidae), in Three Different Districts in Sohag Governorate.

El-Hadary, W. A. and Ali, M. A. M.

Biological Control Research Department, Plant Protection Research Institute, Agriculture Research Center.

Email: abonoraba@gmail.com

ARTICLE INFO

Article History

Received:7/12/2019

Accepted:31/12/2019

Keywords:

The *Zizyphus spina-christi*, Pests, The *Zizyphus* fruit fly *Carpomyia incompleta*, The parasitoid *P. concolor*, Parasitism, Biological aspects.

ABSTRACT

In Egypt, The Nabq trees (*Zizyphus spina-christi* (L.)), (Family: Rhamnaceae) are considered as an important host plant having high medical economic value. These trees are attacked by many insect pests, where they seemed to be the sole recorded host plant of the monophagous fruit fly species; the *Zizyphus* fruit fly *Carpomyia incompleta* Becker (Diptera: Tephritidae) from the viable literatures A field study was performed to survey the population dynamics of the pest in the three different districts (Shandaweel, Gohena, and Balasfora) in Sohag Governorate, during two periods at the beginning of the fruit maturation from March to June (in the first period) and from September to November (in the second period), in the two successive season 2016 and 2017. The obtained results indicated that the *Zizyphus* fruit fly was found to be parasitized by the common parasitoid *Psytalia (Opus) concolor* Szépl. (Hymenoptera: Braconidae). However, the general sex ratios obtained between (the pest and the commonly recorded parasitoid), clearly indicated these ratios were greatly towards females than males in the case of both the pest and the parasitoid. Where the occurrence of the parasitoid was related was that of its insect host during two periods of the beginning of the fruit maturation. Magnifying this natural role of the parasitoid *P. concolor* becomes necessary in order to encourage this beneficial agent to do its role and decrease the degree of infestation by the *Zizyphus* trees or other fruit trees that may be subjected to the *Zizyphus* fruit fly attack to an acceptable level. Moreover, this parasitoid could be laboratory mass-reared and released against the pest on the *Zizyphus* trees or other fruit trees that are subjected to attack by the other common fruit flies and must be taken into consideration when applying I.P.M. programs (including the use of the biological control techniques). So, the *Zizyphus* trees are considered as a suitable host plant acting as a natural resource or reservoir for the parasitoid *P. concolor* that attacks the *Zizyphus* fruit fly.

INTRODUCTION

More than 40 *Zizyphus* species (family: Rhamnaceae) are widely spread in the Mediterranean region, Africa, Australia, and tropical America. The *Zizyphus spina-christi*

(L.) is distributed throughout the tropical and sub-tropical regions of the world (Johnston, 1963) and it is a spiny shrub or small tree of economic importance that strongly resists heat and drought (Saied *et al.*, 2008). In Egypt, it is known as Nabq (Taekholm, 1974) and is widely especially cultivated in Assiut and Sohag Governorates, where its occurrence comes after citrus, dates, and pomegranate in Upper Egypt (Darwish *et al.*, 2012). In addition to their popular fruit-eating, it is used for various medical purposes (Shahat *et al.*, 2001) where; these fruits are also used for bronchitis, cough, and tuberculosis (Duck, 1985). They also play an obvious role in soil conservation such as the stabilization of sand dunes (Gebauer *et al.*, 2007). The Nabq (*Zizyphus*) fruits are highly susceptible to the infestation with the *Zizyphus* fruit fly *Carpomyia incompleta* Becker (Diptera: Tephritidae), (Farghal *et al.* 1981), which lays its eggs under the fruit epidermal layer (Ciceoi *et al.*, 2017).

The indiscriminate and extensive use of chemical insecticides had lead to environmental pollution and toxicity of mammals and beneficial organisms (Abdel-Rahman *et al.*, 2005). Recently, biological control techniques were developed as the main component of Integrated Pest Management (I.P.M.) (Hepdurgun *et al.*, 2009). So, efforts were concentrated towards studying the important role of the natural enemies; such as parasitoids in suppressing many harmful insects' pests attacking different agricultural plants (El-Khawas & Shoeb, 2004).

The sub-family Opiinae parasitoids can oviposit in either the eggs or the larval stages of their host and they emerge from the host puparium (Wharton, 1997). One of the common parasitoids is the braconid parasitoid *Psytalia (Opius) concolor* Szépl. (Hymenoptera: Braconidae) that is commonly found in Southern Europe and Africa. Its original description was based on the material collected from olives fruits infested with the olive fruit fly *Bactrocera oleae* and later was included as *P. concolor* in the *Psytalia* subgenus *Psytalia*; this subgenus was subsequently elevated to generic rank by Wharton (1987). The parasitoid *P. concolor* is a koinobiont larval-pupal endoparasitoid of at least fourteen tephritids (Diptera) on many different wild and/or cultivated plants (Benelli & Canale, 2013). The parasitoid develops on the tephritid larvae that live on a wide range of small spherical fruits, generally drupes, or small globular inflorescences (Benelli & Canale, 2012). Generally, the present study aims to study the population densities of the *Zizyphus* fruit fly *C. incompleta* and also its parasitism by the common parasitoid *P. concolor*, during the two successive seasons, 2016 and 2017, in two different periods; from the last week of March-the first week of June (the first period of fruit production) and from the second week of September-the second week of November (the second period of fruit production), in three different districts (Shandaweel, Gohena, and Balasfora) in Sohag Governorate.

MATERIALS AND METHODS

The present study was carried out in three *Zizyphus* orchards (each of one feddan), located in three different districts (Shandaweel, Gohena, and Balasfora) in Sohag Governorate, in two different periods; from the last week of March-the first week of June (the first period of fruit production) and from the second week of September-the second week of November (the second period of fruit production), in the two successive seasons, 2016 and 2017. Twenty cultivated *Zizyphus* trees in each locality, with the same age (nearly 15 years old) and size were selected for sampling and serve as replicates during the study. No chemical insecticides were applied in the *Zizyphus* orchard for the two periods of investigation; only the normal agricultural practices were performed. The biweekly total sample of about two kilograms of the fallen fruits under the twenty *Zizyphus* trees was randomly collected in paper bags and carefully directly brought to the laboratory for their examination in Shandaweel Agricultural Research Station. The biweekly fallen collected *Zizyphus* fruits samples were put in a desiccator, where, prior to experimentation, sand samples were washed, air-dried, sifted

through a 2-mm mesh metal sieve and dried in a desiccator for 6 h at 80°C to kill any arthropods. A layer of sand of 2 cm was placed on the bottom of the desiccator as a suitable media for the pest larvae to pupate. To get the pupae of the *Zizyphus* fruit fly *C. incomplete*, the sand layer was sieved every 24 hours and collected pest pupae were directly counted. To obtain the parasitoids for this trial, the collected pest pupae were placed in a black jar that was connected with a transparent plastic vial. This unit was daily observed until the emergence of *P. concolor* parasitoids, where these emerged parasitoids were attracted to the light in the transparent vial. The emerged parasitoids were identified in the Biological Control Research Department, then they were counted, where the plastic vials were daily replaced and supplied with a piece of cotton dipped in a solution of 10% sugar solution + yeast powder for feeding of emerged parasitoids. Also, the percentages of emergence of both the pest and the parasitoid, the percentages of failure of fruit flies emergence and sex ratio ($\text{♂♂}:\text{♀♀}$) of both (the *Zizyphus* fruit fly *C. incomplete* & parasitoid *P. concolor*), the periods of emergence in days for both (the pest & the parasitoid) and also the percentages of pest parasitism by the common parasitoid *P. concolor*. The weather factors including the means of the temperature and the relative humidity were obtained from the Meteorological Station at A.R.C. (Table, 1).

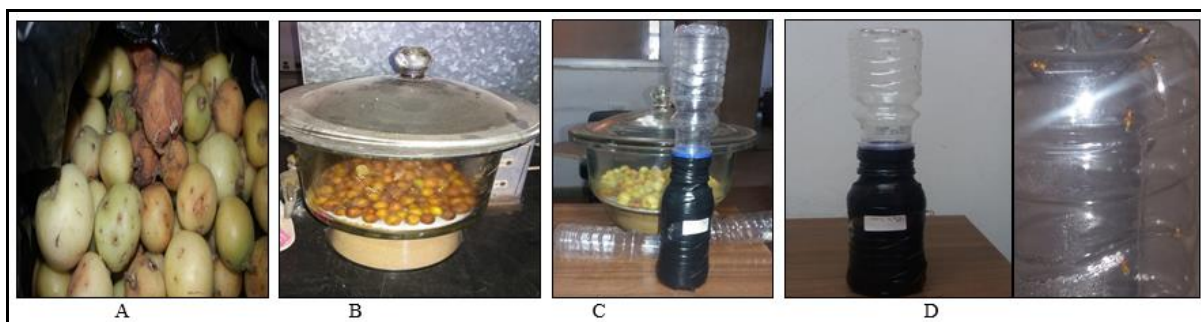


Fig. (1): The infestation of fallen *Zizyphus* fruits by the *Zizyphus* fruit fly *C. incomplete* and pest parasitism by the braconid parasitoid *P. concolor*.

A = Samples of infested fallen *Zizyphus* fruits.

B = A desiccator for collecting pest pupae.

C = A plastic black vials for parasitoids collection that was daily replaced.

D = Positive white insect separator for the braconid parasitoid *P. concolor* that was directly attracted to the light

RESULTS AND DISCUSSION

I- Field Studies Including the Population Fluctuation of the *Zizyphus* Fruit Fly, *C. incompleta* and Its Parasitism by the Parasitoid, *P. concolor*.

Data obtained concerning the population density of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits and the pest parasitism by the parasitoid *P. concolor* were recorded in Tables (2, 3,4 &5), in three different districts (Shandaweel, Gohena, and Balasfora) in Sohag Governorate, during the two successive seasons, 2016 and 2017.

1- The First Period of the Beginning of Fruit Maturation (From the Last Week of March-The First Week of June):

Data obtained concerning the population density of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits and the pest parasitism by the parasitoid *P. concolor*, for the first period of beginning of fruit maturation (from the last week of March-the first week of June) were recorded in Tables (2&3), in three different districts (Shandaweel, Gohena, and Balasfora) in Sohag Governorate, during the two successive seasons, 2016 (at mean of temperature of 27.60 c° (20.60-35.40 c°) & means of relative humidity of 32.18%

(20.60-51.20%)) and 2017 (at mean of temperature of 27.47c° (20.90-34.20 c°) & means of relative humidity of 33.17% (26.50-38.00%)) per the period (Table, 1).

Table 1: The weather factors that represent the means of the temperatures and the means of the relative humidity, during the two successive seasons 2016 and 2017, in Sohag Governorate

Season 2016			Season 2017			Mean /2seasons	
Dates	Mean c°	Mean R.H.%	Dates	Mean c°	Mean R.H.%	Mean c°	Mean R.H.%
The first period of fruit production							
25/3/2016	25.70	31.00	28/3/2017	20.90	33.50	23.30	32.25
4/4	25.20	30.00	7/4	21.70	34.20	23.45	32.10
14/4	20.60	51.20	17/4	21.90	38.00	21.25	44.60
24/4	31.30	22.80	27/4	33.80	35.80	32.55	29.30
4/5	25.00	39.20	7/5	26.00	35.00	25.50	37.10
14/5	33.00	25.80	17/5	29.80	33.40	31.40	29.60
24/5	24.60	36.80	27/5	31.50	26.50	28.05	31.65
3/6	35.40	20.60	6/6	34.20	29.00	34.80	24.80
Mean/period	27.60c° (20.60-35.40)	32.18% (20.60-51.20)	Mean/period	27.47c° (20.90-34.20)	33.17% (26.50-38.00)	27.53c° (21.25-34.80)	32.67% (24.80-44.60)
The second period of fruit production							
10/9/2016	29.00	44.10	8/9/2017	27.00	49.00	28.00	46.55
20/9	29.40	37.50	18/9	28.40	44.30	28.90	40.90
30/9	24.90	57.00	28/9	25.10	52.90	25.00	54.95
10/10	27.60	41.10	8/10	30.30	32.70	28.95	36.90
20/10	22.30	55.30	18/10	23.20	44.30	22.75	49.80
30/10	23.80	52.60	28/10	21.40	41.80	22.60	47.20
9/11	23.50	43.30	7/11	17.40	58.80	20.45	51.50
Mean/period	25.78c° (22.30-29.40)	47.27% (37.50-57.00)	Mean/period	21.68c° (17.40-30.30)	46.25% (32.70-58.80)	25.23c° (20.45-28.95)	46.77% (36.90-54.95)

A- In Shandaweel District:

The total numbers of pest pupae collected from the fallen *Zizyphus* fruits (that were attacked by the *Zizyphus* fruit fly *C. incompleta*), were 120&108 in the last weeks of March, 2016 and 2017, respectively. After that, the total number of pest pupae increased until reaching their maximum total number (263&271 pupae) during the last week of April, 2016 and the third week of May, 2017, respectively. The occurrence of the pest adults' flies covered the four months of the study from the last week of March to the first week of June in both 2016 and 2017 seasons. The total numbers of pest pupae population recorded per the first period of beginning of fruit maturation were; 1707&1770 pupae, in seasons 2016 and 2017, respectively. The population density of adult flies of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits were 77&72 in the last week of March, 2016. After that, the flies started gradually to increase until reaching their maximum total numbers (175&185 adult flies) during mid. May, 2016 and the third of May & the first week of June, 2017. The occurrence of the pest adult flies covered the four months of the study from the last week of March to the first week of June in both 2016 and 2017 seasons. The total numbers of adult flies population per period were; 1096&1174 adult flies in seasons 2016 and 2017, respectively. The mean total percentages of failure for the pest adult flies to emerge from their pupae per the first period of the beginning of fruit maturation were 2.98&3.90%, while the mean total percentages of adult flies emergence from their pupae were 64.21&66.33%. The general sex ratio (♂♂:♀♀) of the pest adult flies per period were; 1:1.28&1:1.30, for 2016 and 2017 seasons, respectively, indicating the occurrence of emerged higher females than males adult flies in this period (Tables, 2&3).

As for the parasitoid *P. concolor* that emerged from the infested pupae of the *Zizyphus* fruit fly *C. incompleta* (that were collected from the fallen *Zizyphus* fruits), the total numbers of the parasitoids of *P. concolor* were; 40&31 in the beginning of the period in the first week of March, 2016 and 2017, respectively. After that, the total numbers of the

parasitoid *P. concolor* increased until reaching their maximum total numbers (102&86 adults) during the second week of April, 2016 and the third week of April, 2017, respectively, with the highest percentages of parasitism of 41.30&37.39% during the same previous weeks, respectively and the mean total percentages of parasitism of 32.81&29.77%, for 2016 and 2017 seasons, respectively. The occurrence of the parasitoid covered the four months of the study from the last week of March to the first week of June in 2016 and 2017 seasons. The total numbers of recorded parasitoids per the first period of the beginning of fruit maturation were; 560&527 adults in seasons 2016 and 2017, respectively. The sex ratio ($\sigma\sigma : \rho\rho$) of the parasitoid *P. concolor* adults per period were; 1:1.76&1:1.82, for 2016 and 2017 seasons, respectively, indicating also the occurrence of higher females parasitoids adults than males similar to that occurred in case of the pest. However, the obtained results revealed that the occurrence of the parasitoid *P. concolor* was greatly related to that of its host (the *Zizyphus* fruit fly *C. incompleta*), i.e., there was a positive natural relationship between the parasitoid and its pest on the *Zizyphus* trees in this district, in the two successive seasons 2016 and 2017 (Tables, 2&3).

Table 2: The total numbers of the *Zizyphus* fruit fly *C. incompleta* pupae, the percentages of pest emergence and sex ratio and also the percentages of pest parasitism by the parasitoid and sex ratio of the parasitoid, during the first period of season 2016, in the three different districts.

Dates	Pl.	The <i>Zizyphus</i> fruit fly <i>C. incompleta</i>				The parasitoid <i>P. concolor</i>			
		Total no. of pupae	% Failure to emerge	Total no. of flies	% Flies emergence	Sex ratio*	Total no.	% Parasitism	Sex ratio
25/3/2016	1	120	2.50	77	64.17	1:1.48	40	33.33	1:1.35
	2	133	4.51	76	57.14	1:1.53	51	38.35	1:1.43
	3	133	3.76	98	73.68	1:1.28	30	22.56	1:2.00
4/4	1	174	2.88	105	60.34	1:1.19	64	36.78	1:1.56
	2	183	4.02	100	54.45	1:1.22	76	41.53	1:1.45
	3	200	0.00	142	71.00	1:1.45	58	29.00	1:1.90
14/4	1	247	2.83	138	55.87	1:1.51	102	41.30	1:1.68
	2	271	2.95	134	49.45	1:1.58	129	47.60	1:1.69
	3	257	2.33	180	70.04	1:1.69	71	27.63	1:1.54
24/4	1	263	1.90	170	64.64	1:1.98	88	33.46	1:1.26
	2	305	1.96	190	62.30	1:2.17	109	35.74	1:1.32
	3	299	3.68	194	64.88	1:1.98	94	31.44	1:1.61
4/5	1	256	3.51	169	66.02	1.04:1	78	30.47	1:2.39
	2	288	4.47	183	62.54	1:1.61	95	32.99	1:2.65
	3	328	1.53	210	64.02	1:1.76	113	34.45	1:2.32
14/5	1	240	2.50	175	72.92	1:1.24	59	24.58	1:2.47
	2	260	3.07	179	68.85	1:1.32	73	28.08	1:2.48
	3	258	2.32	176	68.22	1:1.51	76	29.46	1:2.30
24/5	1	214	2.81	139	64.95	1:1.11	69	32.24	1:2.63
	2	255	4.31	156	61.18	1:1.14	88	34.51	1:2.03
	3	200	6.00	136	68.00	1:1.39	52	26.00	1:1.89
3/6	1	193	5.18	123	63.73	1:1.08	60	31.09	1:1.40
	2	207	4.35	119	57.49	1:1.29	79	38.16	1:1.19
	3	165	5.45	110	66.67	1:1.34	46	27.88	1:1.88
Total	1	1707	Mean 2.98%	1096	Mean 64.21%	1:1.28	560	Mean 32.81%	1:1.76
	2	1902	3.42%	1137	59.78%	1:1.48	700	36.80%	1:1.70
	3	1840	2.93%	1246	67.72%	1:1.58	540	29.35%	1:1.92

Pl. = places 1- Shandaweel 2- Gohena 3- Balasfora Sex ratio* = ($\sigma\sigma : \rho\rho$)

Table 3: The total numbers of the *Zizyphus* fruit fly *C. incompleta* pupae, the percentages of pest emergence and sex ratio and also the percentages of pest parasitism by the parasitoid and sex ratio of the parasitoid, during the first period of season 2017, in the three different districts.

Dates	Pl.	The <i>Zizyphus</i> fruit <i>C. incompleta</i>					The parasitoid <i>P. concolor</i>		
		Total no. of pupae	% Failure to emerge	Total no. of flies	% Flies emergence	Sex ratio*	Total no.	% Parasitism	Sex ratio
28/3/2017	1	108	4.64	72	66.66	1:1.48	31	28.70	1:1.38
	2	109	7.34	60	55.05	1:1.22	41	37.61	1:1.16
	3	116	5.17	77	66.38	1:1.33	33	28.45	1:1.75
7/4	1	163	3.68	105	64.42	1:1.33	52	31.90	1:1.36
	2	164	6.14	89	54.23	1:1.41	65	39.63	1:1.32
	3	171	2.34	112	65.50	1:1.67	55	32.16	1:1.62
17/4	1	230	4.35	134	58.26	1:1.63	86	37.39	1:1.87
	2	250	5.20	120	48.00	1:1.79	117	46.80	1:1.79
	3	280	2.86	149	53.21	1:1.61	123	43.93	1:2.08
27/4	1	241	33.73	151	62.66	1:1.60	81	3.61	1:1.70
	2	249	4.41	141	56.63	1:1.76	97	38.96	1:1.62
	3	300	3.67	196	65.33	1:1.72	93	31.00	1:1.66
7/5	1	254	5.12	163	64.17	1:1.01	78	30.71	41:2.25
	2	250	3.60	155	62.00	1:1.38	86	34.40	1:1.69
	3	267	3.37	162	60.67	1:1.25	96	35.96	1:1.59
17/5	1	271	3.69	185	68.27	1:1.18	76	28.04	1:1.71
	2	272	5.52	160	58.82	1:1.39	97	35.66	1:1.55
	3	261	3.07	182	69.73	1:1.53	71	27.20	1:1.73
27/5	1	243	3.71	179	73.66	1:1.11	55	22.63	1:2.06
	2	282	2.13	206	73.05	1:1.26	70	24.82	1:1.80
	3	241	1.66	186	77.18	1:1.30	51	21.16	1:1.55
6/6	1	260	2.70	185	71.15	1:1.40	68	26.15	1:2.09
	2	249	3.21	163	65.46	1:1.76	78	31.33	1:3.11
	3	179	2.79	133	74.30	1:1.29	41	22.91	1:1.73
Total	1	1770	Mean 3.90%	1174	Mean 66.33%	1:1.30	527	Mean 29.77%	1:1.82
	2	1825	4.38%	1094	59.95%	1:1.49	651	35.67%	1:1.71
	3	1815	2.03%	1197	65.95%	1:1.46	563	31.02%	1:1.73

B- In Gohena District:

The total numbers of pest pupae collected from the fallen *Zizyphus* fruits (that were attacked by the *Zizyphus* fruit fly *C. incompleta*), were 133&109 in the last weeks of March, 2016 and 2017, respectively. After that, the total number of pest pupae increased until reaching their maximum total number (305&282pupae) during the last week of April, 2016 and the last week of May, 2017, respectively. The occurrence of the pest adults' flies covered the four months of the study from the last week of March to the first week of June in both 2016 and 2017 seasons. The total numbers of pest pupae population recorded per the first period of the beginning of fruit maturation were; 1902&1825 pupae, in seasons 2016 and 2017, respectively. The population density of adult flies of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits were 76&60 in the last week of March, 2016 and 2017, respectively. After that, the flies started gradually to increase until reaching their maximum total numbers (190&206 adult flies) during the last week of April, 2016 and the last week of May, 2017. The occurrence of the pest adult flies covered the four months of the study from the last week of March to the first week of June in both 2016 and 2017 seasons. The total numbers of adult flies population per period were; 1137&1094 adult flies in seasons 2016 and 2017, respectively. The mean total percentages of failure for the pest adult flies to emerge from their pupae per the first period of the beginning of fruit maturation were 3.42&4.38%, while the mean total percentages of adult flies emergence from their pupae were 59.78&59.95%. The general sex ratio ($\sigma^{\sigma}:\rho^{\rho}$) of the pest adult flies per period were;

1:1.48&1:1.49, for 2016 and 2017 seasons, respectively, indicating the occurrence of emerged higher females than males adult flies in this period (Tables, 2&3).

As for the parasitoid *P. concolor* that emerged from the infested pupae of the *Zizyphus* fruit fly *C. incompleta* (that were collected from the fallen *Zizyphus* fruits), the total numbers of the parasitoids of *P. concolor* were; 51&41 in the beginning of the period in the first week of March, 2016 and 2017, respectively. After that, the total numbers of the parasitoid *P. concolor* increased until reaching their maximum total numbers (129&117 adults) during the second week of April, 2016 and the third week of April, 2017, respectively, with the highest percentages of parasitism of 47.60&46.80% during the same previous weeks, respectively and the mean total percentages of parasitism of 36.80&35.67%, for 2016 and 2017 seasons, respectively.. The occurrence of the parasitoid covered the four months of the study from the last week of March to the first week of June in 2016 and 2017 seasons. The total numbers of recorded parasitoids per the first period of the beginning of fruit maturation were; 700&651 adults in seasons 2016 and 2017, respectively. The sex ratio ($\sigma\sigma$: $\rho\rho$) of the parasitoid *P. concolor* adults per period were; 1:1.70&1:1.71, for 2016 and 2017 seasons, respectively, indicating also the occurrence of higher females parasitoid adults than males similar to that occurred in case of the pest. However, the obtained results revealed that the occurrence of the parasitoid *P. concolor* was greatly related to that of its host (the *Zizyphus* fruit fly *C. incompleta*), i.e., there was a positive natural relationship between the parasitoid and its pest on the *Zizyphus* trees in this district, in the two successive seasons 2016 and 2017 (Tables, 2&3).

C- In Balasfora District:

The total numbers of pest pupae collected from the fallen *Zizyphus* fruits (that were attacked by the *Zizyphus* fruit fly *C. incompleta*), were 133&116 in the last weeks of March, 2016 and 2017, respectively. After that, the total number of pest pupae increased until reaching their maximum total number (328&300 pupae) during the first week of May, 2016 and the last week of April, 2017, respectively. The occurrence of the pest adults' flies covered the four months of the study from the last week of March to the first week of June in both 2016 and 2017 seasons. The total numbers of pest pupae population recorded per the first period of the beginning of fruit maturation were; 1840&1815 pupae, in seasons 2016 and 2017, respectively. The population density of adult flies of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits were 98&77 in the last week of March, 2016 and 2017, respectively. After that, the flies started gradually to increase until reaching their maximum total numbers (210&196 adult flies) during the first week of May, 2016 and the last week of April, 2017. The occurrence of the pest adult flies covered the four months of the study from the last week of March to the first week of June in both 2016 and 2017 seasons. The total numbers of adult flies population per period were; 1246&1197 adult flies in seasons 2016 and 2017, respectively. The mean total percentages of failure for the pest adult flies to emerge from their pupae per the first period of the beginning of fruit maturation were 2.93&2.03%, while the mean total percentages of adult flies emergence from their pupae were 67.72&65.95%. The general sex ratio ($\sigma\sigma$: $\rho\rho$) of the pest adult flies per period were; 1:1.58&1:1.46, for 2016 and 2017 seasons, respectively, indicating the occurrence of emerged higher females than males adult flies in this period (Tables, 2&3).

As for the parasitoid *P. concolor* that emerged from the infested pupae of the *Zizyphus* fruit fly *C. incompleta* (that were collected from the fallen *Zizyphus* fruits), the total numbers of the parasitoids of *P. concolor* were; 30&33 in the beginning of the period in the first week of March, 2016 and 2017, respectively. After that, the total numbers of the parasitoid *P. concolor* increased until reaching their maximum total numbers (113&123 adults) during the first week of May, 2016 and the third week of April, 2017, respectively, with the highest percentages of parasitism of 34.45&43.93% during the same previous weeks, respectively

and the mean total percentages of parasitism of 29.35&31.02%, for 2016 and 2017 seasons, respectively. The occurrence of the parasitoid covered the four months of the study from the last week of March to the first week of June in 2016 and 2017 seasons. The total numbers of recorded parasitoids per the first period of the beginning of fruit maturation were; 700&651 adults in seasons 2016 and 2017, respectively. The sex ratio ($\text{♂♂} : \text{♀♀}$) of the parasitoid *P. concolor* adults per period were; 1:1.70&1:1.71, for 2016 and 2017 seasons, respectively, indicating also the occurrence of higher females parasitoid adults than males similar to that occurred in case of the pest. However, the obtained results revealed that the occurrence of the parasitoid *P. concolor* was greatly related to that of its host (the *Zizyphus* fruit fly *C. incompleta*), i.e., there was a positive natural relationship between the parasitoid and its pest on the *Zizyphus* trees in this district, in the two successive seasons 2016 and 2017 (Tables, 2&3).

It was recorded from the obtained data that there was little difference between the three districts in Sohag Governorate in the first period of the beginning of the fruit's maturation, in the case of the host pest (the *Zizyphus* fruit fly *C. incompleta*) and its field parasitism by the parasitoid *P. concolor*.

1- The Second Period of the Beginning of Fruit Maturation (From the Second Week of September-The Second Week of November):

Data obtained concerning the population density of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits and the pest parasitism by the parasitoid *P. concolor*, for the first period of beginning of fruit maturation (from the last week of March-the first week of June) were recorded in Tables (4&5), in three different districts (Shandaweel, Gohena, and Balasfora) in Sohag Governorate, during the two successive seasons, 2016 (at mean of temperature of 25.78c° (22.30-29.40) & means of relative humidity 47.27%(37.50-57.00) and 2017 (at mean of temperature of 21.68c° (17.40-30.30) & means of relative humidity of 46.25% (32.70-58.80) per the period (Table, 1).

A- In Shandaweel District:

The total numbers of pest pupae collected from the fallen *Zizyphus* fruits (that were attacked by the *Zizyphus* fruit fly *C. incompleta*), were 255&235 in the second week of September, 2016 and 2017, respectively. After that, the total number of pest pupae increased until reaching their maximum total number (270&242 pupae) during the last weeks of September, 2016 and 2017, respectively. The occurrence of the pest adults' flies covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of pest pupae population recorded per the first period of the beginning of fruit maturation were; 1474&1414 pupae, in seasons 2016 and 2017, respectively. The population density of adult flies of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits were 202&168 in the last weeks of September, 2016 and 2017, respectively. After that, the flies started gradually to increase until reaching their maximum total numbers (230&189 adult flies) during the last week of September, 2016 and the second week of October, 2017. The occurrence of the pest adult flies covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of adult flies population per period were; 1240&1086 adult flies in seasons 2016 and 2017, respectively. The mean total percentages of failure for the pest adult flies to emerge from their pupae per the first period of the beginning of fruit maturation were 4.62&5.02%, while the mean total percentages of adult flies emergence from their pupae were 84.12&76.80 %. The general sex ratio ($\text{♂♂} : \text{♀♀}$) of the pest adult flies per period were; 1:1.21 & 1:1.32, for 2016 and

2017 seasons, respectively, indicating the occurrence of emerged higher females than males adult flies in this period (Tables, 4&5).

Table 4: The total numbers of the *Zizyphus* fruit fly, *C. incompleta* pupae, the percentages of pest emergence and sex ratio and also the percentages of pest parasitism by the parasitoid *P. concolor* and sex ratio of the parasitoid, during the second period of season 2016, in the three different districts.

Dates	Pl.	The <i>Zizyphus</i> fruit fly <i>C. incompleta</i>					The parasitoid <i>P. concolor</i>		
		Total no. of pupae	% Failure to emerge	Total no. of flies	% Flies emergence	Sex ratio [♂]	Total no.	% Parasitism	Sex ratio
10/9/2016	1	255	3.13	202	79.22	1:1.20	45	17.65	1:1.50
	2	273	2.56	212	77.66	1:1.41	54	19.78	1:1.84
	3	169	2.96	127	75.15	1:1.95	37	21.89	1:2.08
20/9	1	251	4.38	209	83.27	1:1.20	31	12.35	1:2.10
	2	244	4.51	190	77.87	1:1.21	43	17.62	1:1.69
	3	235	2.13	179	76.17	1:1.80	51	21.70	1:2.40
30/9	1	270	5.55	230	85.19	1:1.11	25	9.26	1:1.50
	2	264	3.41	217	82.20	1:1.31	38	14.39	1:2.17
	3	266	1.48	230	86.49	1:1.47	32	12.03	1:1.29
10/10	1	184	4.89	160	86.96	1:1.29	15	8.15	1:2.00
	2	186	6.45	150	80.65	1:1.50	24	12.90	1:1.18
	3	207	3.38	186	89.86	1:1.74	14	6.76	1:1.33
20/10	1	214	4.20	186	86.92	1:1.19	19	8.88	1:1.71
	2	185	4.86	158	85.41	1:1.78	18	9.73	1:1.57
	3	223	1.35	204	91.48	1:1.68	16	7.17	1:1.67
30/10	1	169	4.14	145	85.80	1:1.23	17	10.06	1:1.43
	2	133	8.27	103	77.44	1:1.45	19	14.29	1:1.38
	3	163	4.77	146	89.71	1:1.43	9	5.52	1:2.00
9/11	1	131	6.87	108	82.44	1:1.35	14	10.69	1:1.33
	2	118	5.93	95	80.51	1:1.50	16	13.56	1:2.20
	3	124	4.03	108	87.10	1:2.00	11	8.87	1:1.75
Total	1	1474	4.62%	1240	84.12%	1:1.21	166	11.26%	1:1.63
	2	1403	4.70%	1125	80.19%	1:1.41	212	15.11%	1:1.56
	3	1387	2.66%	1180	85.08%	1:1.68	170	12.26%	1:1.83

As for the parasitoid *P. concolor* that emerged from the infested pupae of the *Zizyphus* fruit fly *C. incompleta* (that were collected from the fallen *Zizyphus* fruits), began with the highest total numbers of the parasitoids of *P. concolor* of 45&55 in the beginning of the period in the second weeks of September, 2016 and 2017, respectively, with the highest percentages of parasitism of 17.65&23.40% during the same previous weeks, respectively and the mean total percentages of parasitism of 11.26&18.18%, for 2016 and 2017 seasons, respectively.. The occurrence of the parasitoid covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of recorded parasitoids per the first period of the beginning of fruit maturation were; 166&257 adults in seasons 2016 and 2017, respectively. The general sex ratio ($\text{♂♂}:\text{♀♀}$) of the parasitoid *P. concolor* adults per period were; 1:1.63&1:1.79, for 2016 and 2017 seasons, respectively, indicating also the occurrence of higher females parasitoids adults than males similar to that occurred in case of the pest. However, the obtained results revealed that the occurrence of the parasitoid *P. concolor* was greatly related to that of its host (the *Zizyphus* fruit fly *C. incompleta*), i.e., there was a positive natural relationship between

the parasitoid and its pest on the *Zizyphus* trees in this district, in the two successive seasons 2016 and 2017 (Tables, 4&5).

Table 5: The total numbers of the *Zizyphus* fruit fly *C. incompleta* pupae, the percentages of pest emergence and sex ratio and also the percentages of pest parasitism by the parasitoid and sex ratio of the parasitoid, during the second period of season 2017, in the three different district

Dates	Pl.	The <i>Zizyphus</i> fruit fly <i>C. incompleta</i>					The parasitoid <i>P. concolor</i>		
		Total no. of pupae	% Failure to emerge	Total no. of flies	% Flies emergence	Sex ratio*	Total no.	% Parasitism	Sex ratio
8/9/2017	1	235	5.11	168	71.49	1:1.15	55	23.40	1:1.75
	2	245	4.08	174	71.02	1:1.56	61	24.90	1:1.90
	3	230	4.08	177	76.96	1:1.33	43	18.96	1:1.87
18/9	1	218	4.13	162	74.31	1:1.42	47	21.56	1:1.35
	2	223	0.89	155	69.51	1:1.77	66	29.60	1:2.14
	3	240	2.92	189	78.75	1:1.55	44	18.33	1:1.44
28/9	1	242	6.20	176	72.73	1:1.48	51	21.07	1:2.00
	2	245	1.64	162	66.12	1:1.53	79	32.24	1:2.04
	3	267	2.62	209	78.28	1:1.75	51	19.10	1:1.68
8/10	1	225	3.11	189	84.00	1:1.36	29	12.89	1:1.64
	2	232	0.00	181	78.02	1:1.59	51	21.98	1:1.55
	3	267	2.62	225	84.27	1:1.68	35	13.11	1:1.06
18/10	1	197	5.07	152	77.16	1:1.45	35	17.77	1:2.18
	2	222	5.41	159	71.62	1:1.65	51	22.97	1:2.00
	3	209	0.00	174	83.25	1:1.72	35	16.75	1:1.50
28/10	1	142	5.43	114	80.28	1:1.04	21	14.79	1:1.33
	2	154	3.89	115	74.68	1:1.45	33	21.43	1:1.06
	3	165	2.42	133	80.61	1:1.33	28	16.97	1:1.33
7/11	1	155	7.09	125	80.65	1:1.31	19	12.26	1:3.75
	2	141	2.12	108	76.60	1:1.35	30	21.28	1:1.31
	3	134	6.72	107	79.85	1:1.37	18	13.43	1:2.60
Total	1	1414	5.02%	1086	76.80%	1:1.32	257	18.18%	1:1.79
	2	1462	2.53%	1054	72.09%	1:1.32	371	25.38%	1:1.77
	3	1512	14.15%	1044	69.05%	1:1.55	254	16.80%	1:1.54

B- In Gohena District:

The total numbers of pest pupae collected from the fallen *Zizyphus* fruits (that were attacked by the *Zizyphus* fruit fly *C. incompleta*), began with the highest total numbers of the parasitoids of *P. concolor* of 273&245 in the second week of September, 2016 and in the second & the last weeks of September 2017, respectively. The occurrence of the pest adults' flies covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of pest pupae population recorded per the first period of the beginning of fruit maturation were; 1403&1462 pupae, in seasons 2016 and 2017, respectively. The population density of adult flies of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits were 212&174 in the last weeks of September, 2016 and 2017, respectively. After that, the flies started gradually to increase until reaching their maximum total numbers (217&181 adult flies) during the last week of September, 2016 and the second week of October, 2017. The occurrence of the pest adult flies covered the three months of the study from the second week of September to the

second week of November in both 2016 and 2017 seasons. The total numbers of adult flies population per period were; 1125&1054 adult flies in seasons 2016 and 2017, respectively. The mean total percentages of failure for the pest adult flies to emerge from their pupae per the first period of the beginning of fruit maturation were 4.70&2.53%, while the mean total percentages of adult flies emergence from their pupae were 80.19&72.09%. The general sex ratio ($\text{♂♂}:\text{♀♀}$) of the pest adult flies per period were; 1:1.41&1:1.32, for 2016 and 2017 seasons, respectively, indicating the occurrence of emerged higher females than males adult flies in this period (Tables, 4&5).

As for the parasitoid *P. concolor* that emerged from the infested pupae of the *Zizyphus* fruit fly *C. incompleta* (that were collected from the fallen *Zizyphus* fruits), the total numbers of the parasitoids of *P. concolor* were; 54&61 in the beginning of the period in the second weeks of September, 2016 and 2017, respectively. The total numbers of the parasitoid *P. concolor* increased until reaching their maximum total numbers (54&51 adults) during the second week of September, 2016 and the last week of September, 2017, respectively, with the highest percentages of parasitism of 21.89&19.10% during the same previous weeks, respectively and the mean total percentages of parasitism of 12.26&25.38%, for 2016 and 2017 seasons, respectively. The occurrence of the parasitoid covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of recorded parasitoids per the first period of the beginning of fruit maturation were; 170&371 adults in seasons 2016 and 2017, respectively. The sex ratio ($\text{♂♂}:\text{♀♀}$) of the parasitoid *P. concolor* adults per period were; 1:1.56&1:1.77, for 2016 and 2017 seasons, respectively, indicating also the occurrence of higher females parasitoids adults than males similar to that occurred in case of the pest. However, the obtained results revealed that the occurrence of the parasitoid *P. concolor* was greatly related to that of its host (the *Zizyphus* fruit fly *C. incompleta*), i.e., there was a positive natural relationship between the parasitoid and its pest on the *Zizyphus* trees in this district, in the two successive seasons 2016 and 2017 (Tables, 4&5).

C- In Balasfora District:

The total numbers of pest pupae collected from the fallen *Zizyphus* fruits (that were attacked by the *Zizyphus* fruit fly *C. incompleta*), were 169&230 in the second week of September, 2016 and 2017, respectively. After that, the total number of pest pupae increased until reaching their maximum total number (266&267 pupae) during the last week of September, 2016 and the last week of September & the second week of October, 2017, respectively. The occurrence of the pest adults' flies covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of pest pupae population recorded per the first period of the beginning of fruit maturation were; 1387&1512 pupae, in seasons 2016 and 2017, respectively. The population density of adult flies of the *Zizyphus* fruit fly *C. incompleta* attacking the fallen *Zizyphus* fruits were 127&177 in the last weeks of September, 2016 and 2017, respectively. After that, the flies started gradually to increase until reaching their maximum total numbers (230&225 adult flies) during the last week of September, 2016 and the second week of October, 2017. The occurrence of the pest adult flies covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of adult flies population per period were;

1180&1044 adult flies in seasons 2016 and 2017, respectively. The mean total percentages of failure for the pest adult flies to emerge from their pupae per the first period of the beginning of fruit maturation were 2.66&14.15%, while the mean total percentages of adult flies emergence from their pupae were 85.08&69.05%. The general sex ratio ($\sigma\sigma:\rho\rho$) of the pest adult flies per period were; 1:1.68&1:1.55, for 2016 and 2017 seasons, respectively, indicating the occurrence of emerged higher females than males adult flies in this period (Tables, 4&5).

As for the parasitoid *P. concolor* that emerged from the infested pupae of the *Zizyphus* fruit fly *C. incompleta* (that were collected from the fallen *Zizyphus* fruits), the total numbers of the parasitoids of *P. concolor* were; 37&43 in the beginning of the period in the second weeks of September, 2016 and 2017, respectively. The total numbers of the parasitoid *P. concolor* increased until reaching their maximum total numbers (51&79 adults) during the third week of September, 2016 and the last week of September, 2017, respectively, with the highest percentages of parasitism of 19.78&32.24% during the same previous weeks, respectively and the mean total percentages of parasitism of 12.26&16.80%, for 2016 and 2017 seasons, respectively. The occurrence of the parasitoid covered the three months of the study from the second week of September to the second week of November in both 2016 and 2017 seasons. The total numbers of recorded parasitoids per the first period of the beginning of fruit maturation were; 170&254 adults in seasons 2016 and 2017, respectively. The sex ratio ($\sigma\sigma:\rho\rho$) of the parasitoid *P. concolor* adults per period were; 1:1.83&1:1.54, for 2016 and 2017 seasons, respectively, indicating also the occurrence of higher females parasitoid adults than males similar to that occurred in case of the pest. However, the obtained results revealed that the occurrence of the parasitoid *P. concolor* was greatly related to that of its host (the *Zizyphus* fruit fly *C. incompleta*), i.e., there was a positive natural relationship between the parasitoid and its pest on the *Zizyphus* trees in this district, in the two successive seasons 2016 and 2017 (Tables, 4&5).

Generally, it was found from the obtained results that:

- 1- There was little difference between the three districts in Sohag Governorate in the first period of the beginning of the fruit's maturation, in case of the host pest (the *Zizyphus* fruit fly *C. incompleta*) and its field parasitism by the parasitoid *P. concolor*.
- 2- The first period of *Zizyphus* fruit production was more in the pest pupae numbers of the *Zizyphus* fruit fly *C. incompleta* and also in the total numbers of the emerged *P. concolor* parasitoids.
- 3- The *Zizyphus* fruit fly *C. incompleta* was found during the all months of the two periods of *Zizyphus* of the beginning of the fruits maturation, where the *Zizyphus* trees were shown to be highly susceptible to the infestation with the *Zizyphus* fruit fly *C. incompleta* by many investigators such as Farghal *et al.* (1981); Darwish *et al.* (2012); Rizk *et al.* (2013) and Ciceoi *et al.* (2017),
- 4- The parasitoid *P. concolor* was found during all months of the two periods of *Zizyphus* of the beginning of the fruit's maturation.
- 5- The parasitoid *P. concolor* parasitoid was recorded parasitizing the pest species by many authors. For example, Morsy (1971) recorded this parasitoid associated with; the *Zizyphus* fruit fly *C. incompleta* Fischer (1987), the olive fruit fly *B. oleae* (Michelakis, 1990; El-Khawas, 2000 and Sime *et al.*, 2006) and the Mediterranean fruit fly *Ceratitis capitata* (Wied.), (Sime *et al.*, 2006). However, because of increasing concerns for the environment

and maintaining a more natural balance of plants and animals in managed systems, the parasitoid is still routinely used in the Mediterranean region for inoculative (Neuenschwander *et al.*, 1986; Jiménez *et al.*, 1990 and Delrio *et al.*, 2005). The parasitoid *P. concolor* has been used in the Mediterranean areas for the biological control of the olive fruit fly *B. oleae* by inundative and inoculative releases (Raspi, 1994) and recently, this braconid was released in USA in California olives groves as a part of local biological control programs (Wang *et al.*, 2011). Besides, (Abdel-Galil *et al.* (2013) indicated that the *Zizyphus* trees must be protected to act as natural resources or reservoirs for *P. concolor* and also can be cultivated around the fruit orchards as windbreaks. Moreover, Canale and Raspi (2000) stated that it is likely on infested fruits, the older host larvae are not easily accessible by the parasitoid *P. concolor* females. The role of the natural enemies in agriculture (as main components of biological control), is widely encouraged through studying their population densities and thus searching for the most available conditions for their reproduction and release (El-Khawas & Shoeb, 2004). For more successful pests' control, the recent developed control strategies have now been directed to know the pest-enemy relationship, where detailed knowledge is hardly required such as; pest biology, population dynamics, as well as, the natural enemies associated with the pest and their impact, to achieve such acceptable control (Mostafa, 2006).

2- Laboratory Biological Studies:

A- Emergence of the *Zizyphus* Fruit Fly, *C. incompleta*.

Data obtained in Tables (6&7) revealed the total numbers of f emergence days of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from pest pupae collected during the first and the second periods of the beginning of the fruit maturation of the two successive seasons 2016 and 2017, of the three different districts in Sohag Governorate.

1- The First Period of the Beginning of Fruit Maturation (From the Last Week of March-The First Week of June), In Seasons 2016 and 2017.

The total numbers of emergence days of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from infested pest pupae collected during the first period of the beginning of the fruit maturation of the two successive seasons 2016 and 2017, of the three different districts were shown in Table (6).

a- In Shandaweel District:

The total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 480♂♂&616♀♀, while the highest total numbers of the pest adults were during 14/5/2016 (78♂♂&97♀♀). In season 2017, the total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 511♂♂&663♀♀, while the highest total numbers of the pest adults were during 17/5/2017 (85♂♂&100♀♀). The occurrence of the pest adults covered all the four months of the study from March to June in seasons, 2016 and 2017 (Table, 6).

b- In Gohena District:

The total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 459♂♂&678♀♀, while the highest total numbers of the pest adults were during 4/5/2016 (70♂♂&113♀♀). In season

2017, the total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 440♂♂ & 654♀♀, while the highest total numbers of the pest adults were during 17/5/2017 (85♂♂ & 100♀♀).. The occurrence of the pest adults covered all the four months of the study from March to June in seasons, 2016 and 2017 (Table, 6).

Table 6: The total numbers of days of the emergence of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from pest pupae collected during the first period of the beginning of fruit maturation of the two successive seasons 2016 and 2017, of the three different districts.

Pl.	Dates	2016										2017										
		1 st day		2 nd day		3 rd day		4 th day		Total/days		1 st day		2 nd day		3 rd day		4 th day		Total/days		
		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	
1	25/3	15	22	9	15	4	8	3	1	31	46	28/3	12	19	10	15	4	8	3	1	29	43
		12	20	11	13	5	10	2	3	30	46		11	14	8	13	6	4	2	2	27	33
		20	25	12	17	6	10	5	3	43	55		9	12	15	18	5	10	4	4	33	44
1	4/4	16	25	18	20	9	10	5	2	48	57	7/4	16	25	18	20	9	10	2	5	45	60
		18	23	14	21	9	10	4	1	45	55		11	22	13	15	10	13	3	2	37	52
		22	34	20	27	11	17	5	6	58	84		14	29	16	23	9	12	3	6	42	70
1	14/4	30	50	14	20	6	8	5	5	55	83	17/4	30	50	10	20	6	8	5	5	51	83
		28	44	16	22	5	10	3	6	52	82		25	45	11	18	4	10	3	4	43	77
		33	63	23	31	7	12	4	7	67	113		23	46	16	26	11	11	7	9	57	92
1	24/4	29	55	20	47	6	8	2	3	57	113	27/4	29	55	20	27	6	9	3	2	58	93
		31	61	23	51	3	12	3	6	60	130		22	43	18	30	7	11	4	6	51	90
		30	57	22	50	8	13	5	9	65	129		32	65	22	33	13	18	5	8	72	124
1	4/5	38	45	30	25	15	11	3	2	86	83	7/5	38	45	25	26	15	9	3	2	81	82
		35	50	23	43	10	16	2	4	70	113		26	41	22	31	12	15	5	3	65	90
		34	54	25	53	11	18	6	9	76	134		33	51	22	21	11	9	6	9	72	90
1	14/5	43	48	21	28	11	18	3	3	78	97	17/5	36	42	30	35	17	20	2	3	85	100
		36	45	26	32	13	21	2	4	77	102		25	35	25	31	12	22	5	5	67	93
		32	51	20	34	14	15	4	6	70	106		33	49	24	30	10	23	5	8	72	110
1	24/5	30	35	22	22	12	15	2	1	66	73	27/5	35	40	25	30	22	19	3	5	85	94
		34	36	21	25	15	17	3	5	73	83		31	45	32	37	22	26	6	7	91	115
		22	36	19	24	13	15	3	4	57	79		37	45	22	31	17	22	5	7	81	105
1	3/6	25	27	20	20	11	14	3	3	59	64	6/6	29	36	26	35	20	33	2	4	77	108
		23	31	15	22	12	10	2	4	52	67		22	32	19	33	15	33	3	6	59	104
		20	26	15	22	10	11	2	4	47	63		22	27	17	23	16	20	3	5	58	75
2	Total	226	307	154	197	74	92	26	20	480	616	Total	225	312	164	208	99	116	23	27	511	663
		217	310	149	229	72	106	21	33	459	678		173	277	148	208	88	134	31	35	440	654
		213	346	156	258	80	111	34	48	483	763		203	324	154	205	92	125	38	56	487	710

c- In Balasfora District:

The total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 483♂♂ & 763♀♀, while the highest total numbers of the pest adults were during 4/5/2016 (76♂♂ & 134♀♀). In season 2017, the total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 487♂♂ & 710♀♀, while the highest total numbers of the pest adults were during 27/4/2017 (72♂♂ & 124♀♀).. The occurrence of the pest adults covered all the four months of the study from March to June in seasons, 2016 and 2017 (Table, 6).

2- The Second Period of the Beginning of Fruit Maturation (From the Second Week of September-The Second Week of November), In the Seasons 2016 and 2017.

The total numbers of emergence days of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from the infested pest pupae collected during the first period of the beginning of the fruit maturation of the two successive seasons 2016 and 2017, of the three different districts were shown in Table (7).

a- In Shandaweel District:

The total numbers of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 562♂♂ & 678♀♀, while the highest total numbers of the pest adults were during

30/9/2016 (109♂♂&121♀♀). In season 2017, the total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 468♂♂&618♀♀, while the highest total numbers of the pest adults were during 8/10/2017 (80♂♂&109♀♀).. The occurrence of the pest adults (males & females) covered all three months of the study from September to November in seasons, 2016 and 2017 (Table, 7).

b- In Gohena District:

The total numbers of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 467♂♂&658♀♀, while the highest total numbers of the pest adults were during 30/9/2016 (94♂♂&123♀♀). In season 2017, the total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 411♂♂&643♀♀, while the highest total numbers of the pest adults were during 8/10/2017 (70♂♂&111♀♀). The occurrence of the pest adults (males & females) covered all three months of the study from September to November in seasons, 2016 and 2017 (Table, 7).

Table 7: The total numbers of days of the emergence of the adults (males & females) of the *Zizyphus* fruit fly, *C. incompleta* that emerged from pest pupae collected during the second period the beginning of fruit maturation of the two successive seasons 2016 and 2017, of the three different districts

Pl.	Dates	2016										2017										
		1 st day		2 nd day		3 rd day		4 th day		Total/days		1 st day		2 nd day		3 rd day		4 th day		Total/days		
		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	
1	10/9	33	38	26	33	22	24	11	15	92	110	8/9	35	45	19	20	18	22	6	3	78	90
	2	27	44	23	40	24	23	14	17	88	124		26	51	21	25	15	25	6	5	68	106
	3	12	25	9	22	12	21	10	16	43	84		32	44	22	25	15	25	7	7	76	101
1	20/9	55	65	20	25	15	17	5	7	95	114	18/9	38	51	15	25	12	15	2	4	67	95
	2	35	46	24	27	20	21	7	10	86	104		32	50	11	30	10	14	3	5	56	99
	3	22	46	22	32	14	25	6	12	64	115		35	55	23	28	12	23	4	9	74	115
1	30/9	62	69	21	23	20	25	6	4	109	121	28/9	36	55	21	25	10	23	4	2	71	105
	2	38	55	27	32	21	31	8	5	94	123		25	47	23	31	11	16	5	4	64	98
	3	42	58	24	32	21	32	6	15	93	137		33	64	24	36	13	25	6	8	76	133
1	10/10	46	55	11	18	9	12	4	5	70	90	8/10	42	55	26	35	10	18	2	1	80	109
	2	41	60	8	15	7	10	4	5	60	90		32	51	22	40	11	15	5	5	70	111
	3	41	63	10	23	11	14	6	18	68	118		35	67	28	43	15	23	6	8	84	141
1	20/10	47	53	19	22	14	19	5	7	85	101	18/10	22	36	26	33	12	18	2	3	62	90
	2	36	57	11	18	9	16	3	8	59	99		19	41	23	37	15	15	3	6	60	99
	3	45	68	15	27	10	22	6	11	76	128		25	48	23	33	11	21	5	8	64	110
1	30/10	36	43	14	19	12	14	3	4	65	80	28/10	22	20	21	23	10	13	3	2	56	58
	2	22	32	10	13	8	12	2	4	42	61		19	24	16	25	7	15	5	4	47	68
	3	33	41	12	24	11	15	4	6	60	86		23	31	20	23	9	15	5	7	57	76
1	9/11	22	31	12	18	10	11	2	2	46	62	7/11	25	31	18	19	9	18	2	3	54	71
	2	15	27	11	14	10	13	2	3	38	57		22	26	14	20	7	13	3	3	46	62
	3	15	35	9	19	9	14	3	4	36	72		23	28	12	19	7	12	3	3	45	62
1	Total	301	354	123	158	102	122	36	44	562	678	Total	220	293	146	180	81	127	21	18	468	618
	2	214	321	114	159	99	126	40	52	467	658	175	290	130	208	76	113	30	32	411	643	
	3	210	336	101	179	88	143	41	82	440	740	206	337	152	207	82	144	36	50	476	738	

c- In Balasfora District:

The total numbers of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per period were; 440♂♂&740♀♀, while the highest total numbers of the pest adults were during 30/9/2016 (93♂♂&137♀♀). In season 2017, the total numbers of the adults of the *Zizyphus* fruit fly *C. incompleta* that emerged from their pupae collected from the fallen *Zizyphus* fruits per the period was; 476♂♂&738♀♀, while the highest total numbers of the pest adults were during 8/10/2017 (84♂♂&141♀♀). The occurrence of the pest adults (males & females) covered all

three months of the study from September to November in seasons, 2016 and 2017 (Table, 7).

B- Emergence of the Parasitoid, *P. concolor* Parasitizing the *Zizyphus* Fruit Fly, *C. incompleta*.

Data obtained in Tables (8&9) revealed the total numbers of emergence days of the adults (males & females) of the *Zizyphus* fruit fly *C. incompleta* that emerged from pest pupae collected during the first and the second periods of the beginning of the fruit maturation of the two successive seasons 2016 and 2017, of the three different districts in Sohag Governorate.

1- The First Period of the Beginning of Fruit Maturation (From the Last Week of March-The First Week of June), In the Two Successive Seasons 2016 and 2017.

The total numbers of emergence days of the adults (males & females) of the parasitoid *P. concolor* that emerged from the infested pest pupae collected during the first period of the beginning of the fruit maturation of the two successive seasons 2016 and 2017, of the three different districts were shown in Table (8).

Table 8: The total numbers of the days of the emergence of the adults (males & females) of the parasitoid *P. concolor* that emerged from pest pupae collected during the first period of the beginning of fruit maturation of the two successive seasons 2016 and 2017, of the three different districts.

Pl.	2016								2017									
	Dates	1 st day		2 nd day		3 rd day		Total/days		Dates	1 st day		2 nd day		3 rd day		Total/days	
		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
1	25/3	9	15	6	5	2	3	17	23	28/3	8	11	4	5	1	2	13	18
2		11	18	6	7	4	5	21	30		10	12	6	8	3	2	19	22
3		5	11	4	6	1	3	10	20		5	12	5	7	2	2	12	21
1	4/4	16	25	7	11	2	3	25	39	7/4	15	19	3	8	4	3	22	30
2		18	30	10	11	3	4	31	45		18	20	6	12	4	5	28	37
3		9	21	8	13	3	4	20	38		11	18	6	9	4	7	21	34
1	14/4	24	47	11	12	3	5	38	64	17/4	25	49	3	5	2	2	30	56
2		28	55	14	20	6	6	48	81		30	52	7	16	5	7	42	75
3		15	26	9	14	4	3	28	43		22	54	13	25	5	4	40	83
1	24/4	29	32	9	15	1	2	39	49	27/4	25	41	2	8	3	2	30	51
2		33	42	11	17	3	3	47	62		28	45	5	11	4	4	37	60
3		22	37	11	17	3	4	36	58		19	33	9	16	7	9	35	58
1	4/5	15	45	6	8	2	2	23	55	7/5	15	44	7	8	2	2	24	54
2		13	53	8	11	5	5	26	69		20	38	8	11	4	5	32	54
3		21	53	9	20	4	6	34	79		17	37	11	16	9	6	37	59
1	14/5	11	28	5	11	1	3	17	42	17/5	25	39	2	6	1	3	28	48
2		10	32	8	15	3	5	21	52		30	47	5	8	3	4	38	59
3		15	33	6	16	2	4	23	53		15	31	8	9	3	5	26	45
1	24/5	15	39	3	9	1	2	19	50	27/5	15	29	2	7	1	1	18	37
2		20	43	6	11	3	5	29	59		18	32	4	10	3	3	25	45
3		12	27	4	5	2	2	18	34		11	23	6	7	3	1	20	31
1	3/6	19	26	3	6	3	3	25	35	6/6	18	36	3	6	1	4	22	46
2		21	29	10	11	5	3	36	43		12	43	5	11	2	5	19	59
3		11	23	3	6	2	1	16	30		9	18	4	7	2	1	15	26
1	Total	138	257	50	77	15	23	203	357	Total	146	268	26	53	15	19	187	340
2		154	302	73	103	32	36	259	441		166	289	46	87	28	35	240	411
3		110	231	54	97	21	27	185	355		109	226	62	96	35	35	206	357

a- In Shandaweel District:

The total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 203♂♂&357♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 14/4/2016 (38♂♂&64♀♀). In season 2017, the total numbers of the adults of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 187♂♂&340♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 17/4/2017 (30♂♂&56♀♀). The occurrence of the parasitoid *P.*

concolor adults covered all the four months of the study from March to June in seasons, 2016 and 2017 (Table, 8).

b- In Gohena District:

The total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 259♂♂&441♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 14/4/2016 (48♂♂&81♀♀). In season 2017, the total numbers of the adults of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 240♂♂&411♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 17/4/2017 (42♂♂&75♀♀). The occurrence of the parasitoid *P. concolor* adults covered all the four months of the study from March to June in seasons, 2016 and 2017 (Table, 8).

c- In Balasfora District:

The total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 185♂♂&355♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 4/5/2016 (34♂♂&79♀♀). In season 2017, the total numbers of the adults of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per the period were; 206♂♂&357♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 17/4/2017 (40♂♂&83♀♀). The occurrence of the parasitoid *P. concolor* adults covered all the four months of the study from March to June in seasons, 2016 and 2017 (Table, 8).

2- The second period of beginning of fruit maturation (from the second week of September-the second week of November), in seasons 2016 and 2017.

Date obtained Table (9) indicated the total numbers of emergence days of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected during the second period of the beginning of the fruit maturation of seasons 2016 and 2017, of the three different districts.

a- In Shandaweel District:

The total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 63♂♂&103♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 10/9/2016 (18♂♂&27♀♀). In season 2017, the total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 92♂♂&165♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 8/9/2017 (20♂♂&35♀♀). The occurrence of the parasitoid *P. concolor* adults covered all three months of the study from September to November in seasons, 2016 and 2017 (Table, 9).

b- In Gohena District:

The total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 78♂♂&134♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 10/9/2016 (19♂♂&35♀♀). In season 2017, the total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the

fallen *Zizyphus* fruits per period were; 134♂♂&237♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 28/9/2017 (26♂♂&53♀♀). The occurrence of the parasitoid *P. concolor* adults covered all three months of the study from September to November in seasons, 2016 and 2017 (Table, 9).

Table 9: The total numbers of the days of the emergence of the adults (males & females) of the parasitoid *P. concolor* that emerged from pest pupae collected during the second period of the beginning of fruit maturation of the two successive seasons 2016 and 2017, of the three different districts.

Pl.	Dates	2016								2017								
		1 st day		2 nd day		3 rd day		Total/days		1 st day		2 nd day		3 rd day		Total/day		
		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	
1	10/9	9	16	7	8	2	3	18	27	8/9	18	29	2	4	0	2	20	35
2		10	20	5	12	4	3	19	35		15	32	4	4	2	4	21	40
3		5	12	3	7	4	6	12	25		10	21	3	5	2	2	15	28
1	20/9	6	12	3	6	1	3	10	21	18/9	17	25	2	1	1	1	20	27
2		8	14	5	8	3	5	16	27		14	36	4	5	3	4	21	45
3		7	18	5	11	3	7	15	36		11	21	5	3	2	2	18	26
1	30/9	6	9	3	5	1	1	10	15	28/9	15	28	1	4	1	2	17	34
2		5	16	5	7	2	3	12	26		18	39	5	8	3	6	26	53
3		5	10	7	5	2	3	14	18		10	25	6	5	3	2	19	32
1	10/10	4	8	1	2	0	0	5	10	8/10	10	15	1	2	0	1	11	18
2		5	8	3	3	3	2	11	13		12	20	5	6	3	5	20	31
3		3	7	2	1	1	0	6	8		12	14	3	3	2	1	17	18
1	20/10	5	7	2	3	0	2	7	12	18/10	6	19	2	3	3	2	11	24
2		3	5	3	5	1	1	7	11		9	23	4	6	4	5	17	34
3		3	5	2	3	1	2	6	10		7	15	5	4	2	2	14	21
1	30/10	4	7	3	3	0	0	7	10	28/10	7	8	1	1	1	3	9	12
2		4	6	3	5	1	0	8	11		11	8	3	6	2	3	16	17
3		2	3	1	2	0	1	3	6		8	12	3	2	1	2	12	16
1	9/11	4	4	1	2	1	2	6	8	7/11	3	11	1	2	0	2	4	15
2		3	6	2	3	0	2	5	11		8	11	3	3	2	3	13	17
3		2	3	2	2	0	2	4	7		3	11	1	2	1	0	5	13
1	Total	38	63	20	29	5	11	63	103	Total	76	135	10	17	6	13	92	165
2		38	75	26	43	14	16	78	134		87	169	28	38	19	30	134	237
3		27	58	22	31	11	21	60	110		61	119	26	24	13	11	100	154

c- In Balasfora District:

The total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 60♂♂&110♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 10/9/2016 (12♂♂&25♀♀). In season 2017, the total numbers of the adults (males & females) of the parasitoid *P. concolor* that emerged from the pest pupae collected from the fallen *Zizyphus* fruits per period were; 100♂♂&154♀♀, while the highest total numbers of the parasitoid *P. concolor* adults were during 28/9/2017 (19♂♂&32♀♀). The occurrence of the parasitoid *P. concolor* adults covered all three months of the study from September to November in seasons, 2016 and 2017 (Table, 9).

Conclusion

Finally, it could be concluded from the present study the importance of the following obtained points:

- 1- The first period of *Zizyphus* fruit production was more in the pest pupae numbers of the *Zizyphus* fruit fly *C. incompleta* and also in the total numbers of the emerged *P. concolor* parasitoids.
- 2-The *Zizyphus* fruit fly, *C. incompleta* and its parasitoid *P. concolor* was found during all months of the two periods of *Zizyphus* fruit production.
- 3- The occurrence of the parasitoid *P. concolor* was related was that of its insect host (the *Zizyphus* fruit fly), magnifying this natural role of the parasitoid *P. concolor* become necessary in order to encourage this beneficial agent to do its role and decrease the degree of

infestation of the *Zizphus* trees or other fruit trees that are subjected to the *Zizphus* fruit fly attack to an acceptable level. So, this parasitoid is a useful biocontrol agent against the *Zizphus* fruit fly and could be laboratory mass-reared and released against the pest on the *Zizphus* trees or other fruit trees that are subjected to attack by the pest or other common fruit flies. This situation will help to increase the efficiency of control against the common fruit flies attacking many of the fruit orchards. It must be taken into consideration that, it is necessary to know this natural role of the parasitoid as an important component in the field of biological control. Where, El-Heneidy & Abdel-Samad, (2001) stated that it is very important to recognize both the positive and the negative interactions that occur between the two primary components of a management system, plant cultivars, and natural enemies when planning Integrated Pest Management (I.P.M.) programs. Moreover, as the *Zizphus* fruit fly, *C. incompleta* like the most of tephritid flies spend a part of its life cycle (the pupal stage) beneath the soil surface, an additional control of the pest was mostly directed toward this stage to avoid the use of the unfriendly insecticides against adults flies on the fruits (Darwish *et al.*, 2012 and Rizk *et al.*, 2013). Therefore, the recommended control techniques must be directed on the infested fruits on the fruit trees by releasing the parasitoid *P. concolor* against the third and the full-grown pest larvae on the fruit trees and also under the soil against pest pupae.

4- All the period of the control of the *Zizphus* fruit fly must be extended during the four successive months from March to June (in the first period) and from September to November (in the second period). As a result, this period of the extensive pest occurrence representing a suitable time for applying for I.P.M. programs against the pest on the trees (including the use of the biological control techniques).

5- As shown in this study, the general ratios obtained between (the pest and the common recorded parasitoid *P. concolor*), clearly indicated these ratios were greatly directed towards females than males in the case of the pest and the parasitoid *P. concolor*.

6- Detecting the statistical analysis relationships that were recorded between the pest fly & the common parasitoid with the means of the temperature and the relative humidity, is very important and necessary and can share as a part of I.P.M. programs against the fruit fly species.

7- The highest numbers of the parasitoid *P. concolor* that were observed during the first day of the emergence period coincided with the occurrence of the highest numbers of the emerged host pest.

8- The highest numbers of the parasitoid *P. concolor* that were observed during the first day of the emergence period coincided with the occurrence of the highest number of the emerged host pest in both 2016 and 2017 seasons.

Acknowledgement

The authors would like to thank Dr. Farouk Abdel-Galil, Professor of Biological Control, Department of Plant Protection, Faculty of Agriculture, Assiut University for guidance and useful advice on the manuscript.

REFERENCES

- Abdel-Galil, F. A.; M. M. A. Rizk ; S. A. H. Temerak and D. Y.A. Darwish (2013). Studies on the parasitoid *Psytalia concolor* Szépliget (Hymenoptera: Braconidae), associated with *Zizyphus* fruit fly, *Carpomyia incompleta* Becker (Diptera: Tephritidae). Faculty of Agriculture, Plant Protection Department, Assiut University, Assiut, Egypt, published online.
- Abdel-Rahman, G. A. ; M. H. Belal ; N. Ibrahim and E. A. Ali (2005). Observations of the toxic effects of some desert plant extracts on the cowpea aphid *Aphis craccivora* Koch. Egypt. J. Agric. Res. 83(2):609-621.
- Benelli, G. and A. Canale (2012). Learning of visual cues in the fruit fly parasitoid *Psytalia conolor* (Szépliget) (Hymenoptera : Braconidae). BioControl. 57:767-777.
- Benelli, G. and A. Canale (2013). Male-male sexual behavior in the parasitic wasp *Psytalia conolor*. Journal of Insect Science, vol.13, article 25, online.
- Canale, A. and A. Raspi (2000). Host location and oviposition behavior in *Psytalia concolor* Szépliget (Hymenoptera : Braconidae). Entomol. Probl. 31:25–32.
- Ciceoi, R.; I. Dobrin; E . S. Mardare; E. D. Dicianu and F. Stănică (2017). Emerging pests of *Zizyphus jujuba* crop in Romania. Scientific Papers. Series B, Horticulture. Vol.LXI, online.
- Darwish, D.Y. A.; F. A. Abdel-Galil, M.M. A. Rizk and S.A.H. Temerak (2012). Multi-correlation Analysis between some vital aspects of *Zizyphus* fruit fly, *Carpomyia incompleta* Becker (Diptera : Tephritidae) and soil characteristics. Assiut J. Agric. Sci. 156: 163, (Special Issue) The 6th Conference of Young Scientists, Fac. Agric., Assiut Univ., May, 13, Assiut, Egypt.
- Delrio, G.; A. Lentini and A. Satta (2005). Biological control of olive fruit fly through inundative releases of *Opius concolor* Szep., Proceedings of the Working Group on Integrated Protection of Olive Crops, Florence, Italy: IOBC/WPRS Bulletin, 30, 53-58.
- Duke, J. A. (1985). CRC Handbook of Medicinal Herbs. CRS Press; Florida; 516.
- El- Heneidy, A. H. and S. S. Abdel-Samad (2001). Tritrophic interactions among Egyptian wheat plants, cereal aphids and natural enemies. Egypt. J. Biol. Pest Control. 11(2):119-125.
- El-Khawas, M. A. M. (2000). Integrated control of insect pests on olive trees in Egypt, with emphasis on biological control. Ph.D. Thesis, Fac. Of Sci., Cairo Univ. Egypt, 247 pp.
- El-Khawas, M. A. M. and M. A. Shoeb (2004). Population fluctuation of the major sap sucking insects and associated natural enemies on potato. Bull.Ent. Soc. Egypt. 81:209-219.
- Farghal, A. I., M. A. A. Morsy and F. A. Abdel-Galil (1981). Effect of soil treated with certain insecticides Jha's and chitin inhibitor on the *Zizyphus* fruit fly and its parasite. 1stInter Cong Soil Poll. Part II; p. 135–146.
- Gebauer, J.; K. El-Sidding; B. A. Tahir; A. A. Salih; G. Ebert and K. Hammer (2007). Exploiting the potential of indigenous fruit trees: *Grewia tenax* in Sudan. Genet Resour Crop Evol. 54:1701-1708.
- Hepdurgun, B.; T. Turanli and A. Zümreoğlu (2009). Control of the olive fruit fly, *Bactrocera oleae* (Diptera: Tephritidae) through mass trapping and mass releases of the parasitoid *Psytalia concolor* (Hymenoptera: Braconidae) reared on irradiated Mediterranean fruit fly. Biocontrol Science and Technology.19: 211-224.

- Jimenez, A.; E. Castillo and P. Lorite (1990). Supervivancia del himenoptero braconido *Opus concolor* Szep. Parasito de *Dacus oleae* Gmelin en Olivares de Jaen. Bol. Sani. Veg. Plagas. 16: 97-103.
- Johnston, M. C. (1963). The species of *Ziziphus* indigenous to United States and Mexico. Am. J. Bot. 50:1020-1027.
- Michelakis, S. E. (1990). The olive fly (*Dacus oleae* Gmel.) in Crete, Greece. Acta Horticulture. 286:371–374.
- Morsy, M. A. A. (1971). Studies on certain fruit pests in Upper Egypt. MSc. Thesis, Fac. Agric. Assiut Univ., Egypt, pp. 103.
- Mostafa, S. M. (2006). Ecological, biological and integrated control studies on the tomato and faba bean leafminers, *Liriomyza sativa* (Blachard) and *Liriomyza trifolii* (Burgess). Ph.D. Thesis, Fac. of Agric., Fayoum Univ., pp.153.
- Neuenschwander, P.; S. Michelakis; E. Kapatos (1986). *Dacus oleae* (Gmel.), pp.115-159. In Entomologie Oleicole. International, Madrid.
- Rizk, M. M. A., F. A. Abdel-Galil, S. A. H. Temerak and D. Y. A. Darwish (2013). Effect of soil type, moisture and sand cover on pupation depth, survival of pupae and adults of *Carpomyta incompleta* Becker under laboratory conditions. J Plant Prot. Path Mansoura Univ. 4:15–22.
- Saied, A.; J. Gebauer and K. Hammer (2008). *Ziziphus spina-christi* (L.): A multipurpose fruit tree. Genet. Resour. Crop. Evol. 55:929-937.
- Shahat, A.A.; L. Pieters; S. Apers; N. M. Nazeif; N. S. Abdel-Azim; D.V Berghe. and A. J. Vlietinek (2001). Chemical and biological investigations on *Zizyphus spina-christi* L. Phytother. Res. 15:593-597.
- Sim, K. R ; K. M. Daane; R. H. Messing and M. W. Johnson (2006). Comparison of two laboratory cultures of *Psytalia concolor* (Hymenoptera: Braconidae), as a parasitoid of the olive fruit fly. Biol. Control. 39: 248-255.
- Taeckholm, V. (1974). Students Flora of Egypt. Cairo Univ: Cairo, Egypt. 345.
- Wang, X.G.; M.W. Johnson; V.Y. Yokoyama; C. H. Pickett and K. M. (2011). Comparative evaluation of two olive fruit fly parasitoids under varying abiotic conditions. BioControl. 56:283-293.
- Wharton, R. A. (1987). Changes in nomenclature and classification of some opiine Braconidae (Hymenoptera). Proc. Entomol. Soc., Washington. 89:61-73.
- Wharton, R. A. (1997). Generic relationships of opiine Braconidae (Hymenoptera) parasitic on fruit-infesting Tephritidae (Diptera). Contributions of the American Entomological Institute. 30:1-53.

ARABIC SUMMARY

دراسات حقلية وبيولوجية معملية على ١. *Psytalia concolor* Szépl. (Hymenoptera: Braconidae) المتطفل على ذبابة النبق *Carpomyia incompleta* Becker the *Zizyphus* fruit fly ، في ثلاثة مناطق مختلفة في محافظة سوهاج.

وانل عبد السميع الحضري و محمد أحمد محمد على
معهد بحوث وقاية النباتات - مركز البحوث الزراعية دقي - جيزة

تعتبر أشجار النبق (Family: The *Zizyphus* (Nabq) trees (*Zizyphus spina-christi* (L.) *Rhamnaceae*)، عائلا نباتيا مهما ذو قيمة طبية عالية. وتتعرض هذه الأشجار للإصابة بالعديد من الآفات الحشرية ، حيث تعتبر العائل الوحيد المسجل من خلال المراجع المتاحة لذبابة النبق *the Zizyphus* fruit fly *Carpomyia incompleta* Becker

وقد تم إجراء دراسة حقلية لحصر تعداد الآفة و كذلك التطفل عليها على أشجار النبق بواسطة الطفيل *Psytalia concolor* Szépl. (Hymenoptera: Braconidae)، في ثلاث مناطق مختلفة لزراعة النبق (شندويل ، جهينة وبلاصافورا) في محافظة سوهاج ، في فترات البداية لنضج الثمار في : الأربعة شهور المتتالية من مارس إلى يونيو (الفترة الأولى) وفي الثلاثة شهور المتتالية من سبتمبر إلى نوفمبر (الفترة الثانية) ، في موسمي الدراسة ٢٠١٦ و٢٠١٧.

أظهرت النتائج أن نسب التطفل بالطفيل *P. concolor* ، ارتبطت ارتباطا وثيقا بتواجد الآفة *C. incompleta* ، خلال فترتي الدراسة ، كما وجد أن النسب الجنسية للآفة وللطفيل (الذكور: الإناث) ، كانت تميل نحو الإناث. وبالتالي تعظيم وتشجيع هذا الدور الطبيعي للطفيل قد أصبح ضروريا للعمل على تخفيض نسبة الإصابة بالآفة على أشجار النبق أو أشجار الفاكهة الأخرى التي قد تصاب بالآفة لمستوى مقبول. كما سجلت زيادة ملحوظة في أعداد الطفيل *P. concolor* ، في الفترات المختلفة التي يتم التواجد للآفة فيها في الموسم الأول ٢٠١٦ بالمقارنة بالموسم الثاني ٢٠١٧. وبذلك يمكن العمل على زيادة الفاعبية للمكافحة الحيوية للعديد من ذباب الفاكهة المهاجم للعديد من أشجار الفاكهة وذلك بالتربية المعملية والإكثار للطفيل ثم إطلاقه في بساتين الفاكهة التي تصاب بالعديد من الأنواع المختلفة من ذباب الفاكهة ، على اعتبار أن ذبابة النبق *C. incompleta* سوف تكون عائلا معمليا مناسب لتربية الطفيل. وينبغي أن تكون هذه المكافحة ضمن برامج المكافحة المتكاملة لذباب الفاكهة (متضمنة الطرق المختلفة للمكافحة الحيوية). وعلى ذلك ، يمكن اعتبار أن أشجار النبق عائل نباتي للحصول على الطفيل *P. concolor* ، من عذارى ذبابة النبق المتطفل عليها وتربيته وإكثاره معمليا ثم إطلاقه لمكافحة الآفة على أشجار النبق أو على أشجار الفاكهة الأخرى التي قد تهاجم بالأنواع المختلفة من ذباب الفاكهة.