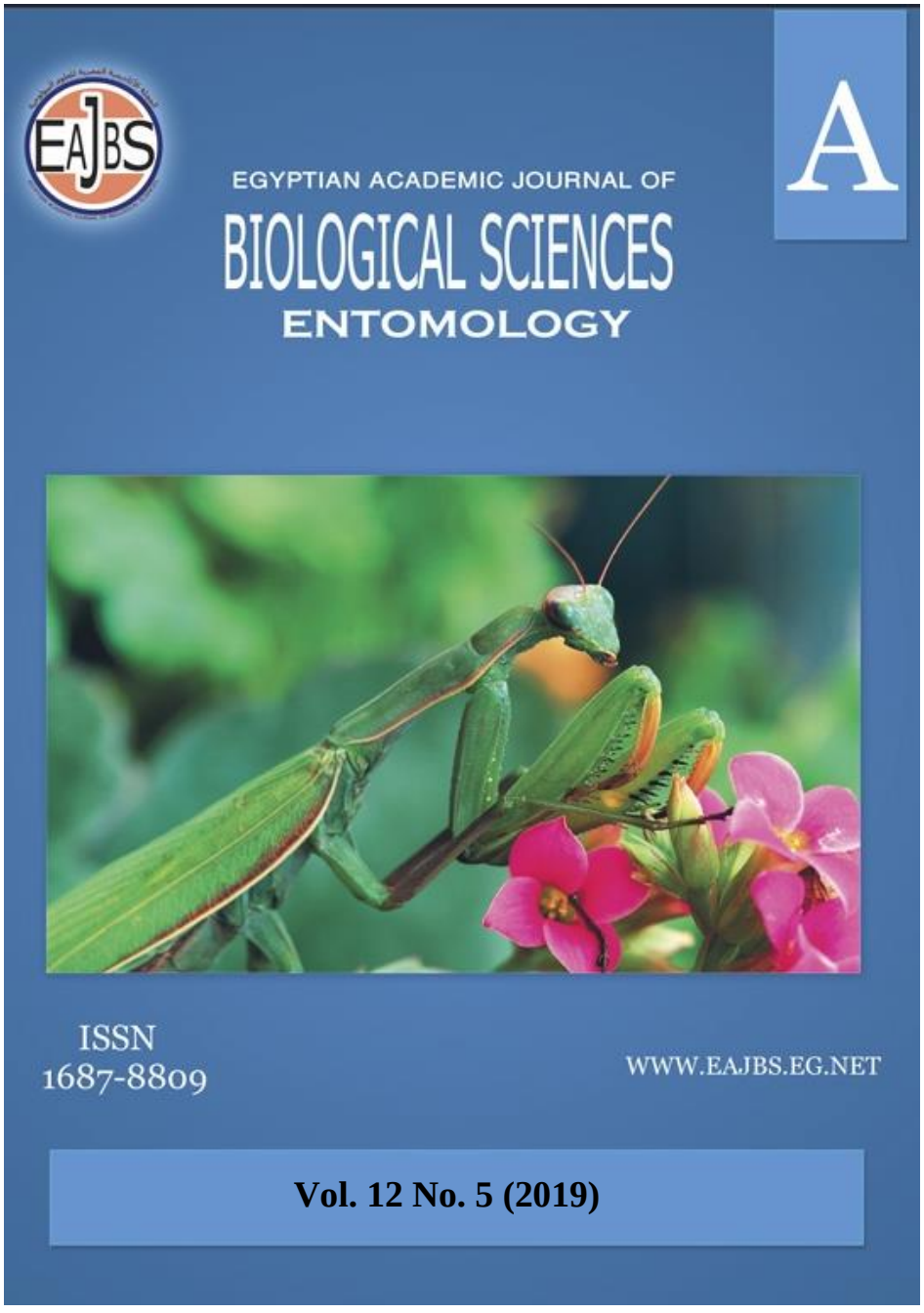

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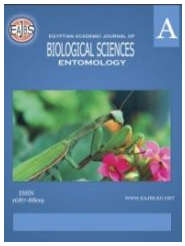

Biotic Factors Responsible for Management the Population Trend of Cabbage Aphid *Brevicoryne brassicae* L, Inhabiting Canola Plants

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ABSTRACT

The present study was conducted to determine the species composition and seasonal abundance of the prevalent arthropod pests and natural enemies inhabiting canola plantations during 2017 and 2018, growing seasons in Assiut, Upper Egypt. Plant relative susceptibility to cabbage aphid *Brevicoryne brassicae* L. and effect of the naturally occurring parasitoid species to manage the population trend of this insect pest was evaluated. Data revealed the presence of 14 species belonging to 14 genera, 10 families and 5 orders. Predatory species (*Campylomma impicta* Wagner and *Coccinella undecimpunctata* L) were constituted the highest proportion of entomophagous species, while parasitoids were presented by one species only [*Diaeretiella rapae* (McIntosh)]. The predatory species showed less than 6% dominance and 40% abundance. However, the aphid parasitoid was presented by more than 90% dominance and 60% abundance. *Thrips tabaci* Lindeman was the highest prevalent phytophagous species, while cabbage aphid *B. brassicae* ranked the second by less dominance and abundance percentages. Cabbage aphid *B. brassicae* was found to be active on canola plantations all over both growing seasons. A gradual increase in *B. brassicae* populations was recorded until the appearance of its peak in March, 5. A gradual decrease in the pest populations was recorded until the end of the season. Bactol cultivar harbored the highest aphid mean numbers (132.47individuals/plant) throughout both seasons of study and classified as susceptible (S) cultivar. Serw 4 and Serw 6 cultivars harbored fewer numbers (98.05 and 85.08 individuals/plant) and classified as low resistant (LR) and moderately resistant (MR) cultivars, respectively. The mean percentage of *B. brassicae* parasitized by *D. rapae* during both growing seasons was estimated. Although, the pest populations decreased at mid-March, the parasitism percentages increased until the end of both seasons. The seasonal mean of parasitism percentage recorded 34.76%. Simultaneous decrease of the pest numbers with the increase of its parasitoid confirms the responsibility of *D. rapae* as a good biological control agent against *B. brassicae* populations.

INTRODUCTION

Canola refers to a wide range of cultivars among three rapeseed species, *Brassica napus* L., *B. rapa*, and *B. juncea* genetically selected to have less than 2% of erucic acid in the oil and less than 30 µmol per gram glucosinolates in the oil-free meal. In addition, canola has a

high capacity of nitrogen accumulation and prevents nitrogen loss from leaching (Nansen *et al.* 2012). Knowledge about canola production in Egypt is still lacking. Meanwhile, few investigations have been concerned with canola insect pests in Upper Egypt (Ahmed, 2006; Mohammed, 2011; Temerak *et al.*2014; Amro, 2016). Aphid species and thrips were considered among the serious canola insect pests which can cause severe damage to canola plants and consequently reduce its yield income. Several authors reported that the most dominant aphid species infesting canola plantations were the cabbage aphid *Brevicoryne brassicae* L., the green peach aphid *Myzus persicae* (Sultz.), and the turnip aphid *Lipaphis erysimi* (Kaltenbach). Some researchers studied the population fluctuations of canola aphids (Rohilla *et al*.1996, Soljoqi *et al*. 2011). However, few investigators have been concerned with the varietal resistance of canola against aphid species (Moharamipour *et al.* 2003; Pontoppidan *et al.* 2003). Considering the difficulties associated with aphid control, there is one environmentally safe control method, which is to use natural enemies, especially parasitoids. Aphid parasitoid *Diaeretiella rapae* (McIntoch) (Hymenoptera: Aphidiidae) is reported to be an important and promising endoparasitoid of more than 60 aphid species, including the cabbage aphid (Hagvar and Hofsvang, 1991). Impact of *D .rapae* against *B .brassicae* took attention by several investigators (Mussury and Fernandes, 2002; Zhang and Hassan, 2003; Desneux *et al.*, 2005; Stark and Acheampong, 2007). The aim of this manuscript is to determine species composition and population trends of the major insect pests infesting the cultivated canola cultivars in Egypt. Study the relative susceptibility of plant cultivars to *B. brassicae* and relation with its associated naturally occurring biological control agents was in consideration.

MATERIALS AND METHODS

The present investigation was conducted at the experimental farm of Assiut University during 2017 and 2018 seasons on canola plants. An area of Ca. 1/4 feddan was divided into plots. Each plot was 1/400 of feddan (6 rows/plot). Three local canola cultivars (Bactol, Serw 4 and Serw 6) were planted on 1st December 2016 as well as 2017 in randomized complete block design. Regular conventional agricultural practices were normally performed and insecticides were completely prevented.

Faunitic Composition of Arthropod Pests and Natural Enemies Inhabiting Canola Plantations:

Two sampling methods have been used to determine the population trends of arthropods inhabiting canola plants and their associated natural enemies. Sweep net technique and whole plant examinations were used. A standard sweeping net (35 cm. diam.) as described by **Borror *et al*., (1979)** was used. Samples of 5 double sweeps, addition to 5 canola plants/plot were taken weekly at random (4 replicates). Samples were kept in polyethylene bags until examined in the laboratory by using stereomicroscope. Collected specimens were preserved and identified by the specialists of the taxonomy department of the Plant Protection Research Institute (Agricultural Research Center (A.R.C.) Dokki, Giza, Egypt.

Seasonal Abundance of Arthropods Inhabiting Canola Cultivars:

1- Dominance and Abundance Percentages of the Recovered Species:

Dominance and abundance degrees of the collected species were estimated according to the formula of **Facylate (1971)** as follow:

$$D = \frac{t}{T} \times 100, \text{ Where}$$

D = Dominance percentage

t = Total number of each species during the collecting period.

T = Total number of all species collected during the collecting period.

$$A = \frac{n}{N} \times 100, \text{ Where}$$

A = Abundance percentage
n = Total number of samples in which each species appeared.
N = Total number of samples taken all over the season.

2- Population Trend of The Cabbage Aphid *Brevicoryne brassicae* L.:

Samples were examined from February, 5 until mid-April when arthropods and their natural enemies declined to low or undetectable levels. The numbers were counted and recorded at each inspection date.

Relative Susceptibility of Canola Cultivars against *Brevicoryne brassicae* L.:

Classification of the susceptibility degree of canola cultivars was based on the general mean ($\overline{X}$) and the standard deviation (SD) as reported by Chiang and Talekar (1980) and Talekar and Chen (1983). This method enabled the classification of cultivars into 5 categories. The cultivars that harbored mean numbers more than $\overline{X}$ + 2SD considered highly susceptible (HS); between $\overline{X}$ and $\overline{X}$ + 2SD, susceptible (S); between $\overline{X}$ and $\overline{X}$ - 1SD, low resistant (LR); between $\overline{X}$ - 1SD to $\overline{X}$ - 2SD, moderately resistant (MR) and less than $\overline{X}$ - 2SD, were considered highly resistant (HR).

Effect of the Aphid Parasitoid *Diaeretiella rapae* on *Brevicoryne brassicae* Populations:

Percentage mortality (parasitism %) caused by aphid parasitoids was calculated in each sampling date according to Feng *et al.* (1992) as follows:

$$\text{Parasitism } \% = \frac{\text{Number of parasitise d(mummified) aphids}}{\text{Total number of aphids}} \text{x100}$$

Statistical Analysis:

Data obtained were statistically analysed using F-test. Means were compared according to Duncan's Multiple Range Test (Steel and Torrie, 1982).

RESULTS AND DISCUSSION

Faunitic Composition of Arthropod Pests and Natural Enemies Inhabiting Canola Plantations:

A partial taxonomic list of arthropods inhabiting three canola cultivars during 2017 and 2018 canola growing seasons at Assiut was shown in Table (1). Data revealed the presence of 14 species belonging to 14 genera, 10 families and 5 orders. Both phytophagous and entomophagous species were presented by 14 species. Predatory species were constituted the highest proportion of entomophagous species (6 species), while parasitoids were presented by one species only. The highest frequent species were belonging to three orders vs. Thysanoptera, Homoptera, and Hymenoptera. The highest frequent phytophagous species (*Thrips tabaci* Lindeman and *Brevicorine brassicae* L.) were captured by sweeping net. However, the highest frequent parasitoid species, *Diaeretiella rapae* (Mclntoch) was collected by the direct count method. The remaining species, either phytophagous or predacious were collected almost by sweeping net and showed frequent and/or rare presentation. Most of the recovered species were previously collected by Mohammed (2011) and Amro (2016) in the same area of study. Population trends and species richness of aphids and natural enemies inhabiting canola was evaluated by **Abbas *et al.* (2017)** in Pakistan**.** They reported that maximum natural enemy population recorded was of ladybird beetle, followed by green lacewing and syrphid fly.

Seasonal Abundance of Arthropods Inhabiting Canola Cultivars:

1- Dominance and Abundance Percentages of the Recovered Species:

Dominance and abundance percentages of the recovered species during 2017 growing season were estimated in Table (2). Data revealed that *Thrips tabaci* was the highest prevalent phytophagous species with an average of 48.34, 51.36 and 50.79 % dominance and 100% abundance on Bactool, Serw 4 and Serw 6 canola cultivars, respectively. Cabbage aphid *B. brassicae* ranked the second by less dominance and abundance percentages. Concerning the entomophagous species, the aphid parasitoid *D. rapae* ranked the first and presented by more than 90% dominance and 60% abundance on the three tested above mentioned canola cultivars. Both of the predatory species (*Campylomma impicta* Wagner and *Coccinella undecimpunctata* L) showed less than 6% dominance and 40% abundance on all of the tested canola cultivars. In a comparison between the phytophagous and entomophagous species, the first group constituted more than 95% dominance and less than 5% abundance on the three tested canola cultivars. A similar trend was obtained during the second season of study (2018) as showed in (Table 3). In this approach, Mohammed (2011) and Amro (2016) reported that *B. brassicae* abundance, nevertheless presented lower than 80% on canola cultivars. However, the aphid parasitoid *D. rapae* revealed the highest dominance and abundance percentages when compared with the predatory group.

2- Population Trend of the Cabbage Aphid *Brevicoryne brassicae* L.

The seasonal abundance of *B. brassicae* inhabiting canola plants during 2017 and 2018 growing seasons at Assiut was presented in Table (4). Cabbage aphid *B. brassicae* was found to be active on canola plantations all over both growing seasons. As a mean of both seasons, this insect pest was recorded in quite low numbers in February 5 (first inspection date) with an average of 89.61, 82.45 and 79.36 individuals/plant on Bactol, Serw 4 and Serw 6 canola cultivars, respectively. A gradual increase in the pest numbers was recorded until the appearance of its peak at March 5 with an average of 184.44, 149.56 and 114.83 individuals/plant on the above-mentioned canola cultivars, respectively. A gradual decrease in the pest numbers was recorded until the end of the season. Variations between the inspection dates showed high significant values (f=33.92**, 28.20** and 26.33**) between the tested cultivars. It is important to note that Bactol cultivar harbored the highest seasonal mean numbers with an average of 132.47 individuals/plant and found to be equal 1.35 and 1.50 fold of those recorded on Serw 4 and Serw 6 cultivars, respectively. So, variations between the tested cultivars showed high significant value (f=15.34**). Surrounded biotic and abiotic factors responsible for the reduction in the pest numbers need more studies in the future. Spatial distribution of *B. brassicae* and its parasitoid, *D. rapae* was studied by Verma *et al.* (2019) on cauliflower (*Brassica oleracea* var *botrytis*) under sub-temperate conditions of India. Both *B. brassicae* and *D. rapae* assumed activity in the fourth week of January and remained active till the end of May with peak activity during fourth week of March.

Relative Susceptibility of Canola Cultivars against *Brevicoryne brassicae* L.:

Depending on the seasonal mean numbers and standard deviation (SD), the relative susceptibility of the tested cultivars divided into three categories (Table 4). According to the obtained results, Bactol cultivar harbored the highest aphid mean numbers (132.47 individuals/plant) as an average of both seasons of study and classified as susceptible (S) cultivar. Serw 4 cultivar harbored fewer numbers with an average of 98.05 individuals/plant and classified as low resistant (LR) cultivar. It is important to note that, Serw 6 cultivar showed some sort of resistance by harboring the least mean numbers of *B. brassicae* with an average of 85.08 individuals/plant and classified as moderately resistant (MR) cultivar. Factors responsible for enhancing the host plant to show resistance degree against this insect pest could be due to one of the resistance categories (antiexenosis, antibiosis, and tolerance) explained by (Knipling, 1979). In this approach, Khan and Begum (2005) in Pakistan studied

the varietal resistance of certain canola varieties against canola aphids. Although the selected varieties showed different agronomical characteristics, the obtained data showed that none of the varieties was resistance to the attack of aphids. Also, Fathi *et al*. (2010) determined the population density of *Myzus persicae* on 19 canola cultivars. To evaluate the resistance status of the tested cultivars, they measured mean numbers of aphids per plant; female progeny; survival rate, the intrinsic rate of increase (r_m) and population growth (λ). On leaves of seven genotype of canola at a constant temperature of 22.5 °C, total developmental time of *B. brassicae*, net reproductive rate and intrinsic rate of increase were evaluated by Anzabi *et al.* (2014). Depending on the aforementioned phenomenon resistance to cabbage aphid has been measured.

Effect of the Aphid Parasitoid *Diaeretiella rapae* on *Brevicoryne brassicae* Populations:

The mean percentage of *B. brassicae* parasitized by *D. rapae* during 2017 and 2018 growing seasons at Assiut governorate was estimated as shown in Table (5). It is clear that; *D. rapae* was associated with *B. brassicae* during the entire seasons of study. The parasitism rate simultaneously increased as *B. brassicae* populations increased. Although, the insect pest populations decreased at mid-March, the parasitism percentages by *D. rapae* increased until the end of both seasons. The seasonal mean of parasitism percentage recorded 34.76%. Synchronization of the pest numbers reduction at mid-March with the increase of its parasitoid has been considered as evidence of the responsibility of *D. rapae* to serve as a good biological control agent against *B. brassicae* populations. Relations between *B. brassicae* and its parasitoids were clarified by several investigators. Lotfalizadeh (2002) surveyed *D. rapae* amongst parasitoids of the cabbage aphid, *B. brassicae* on rapeseed (*Brassica napus*) in the Moghan region, northwest of Iran, as the most important parasitoid. The author reported that, the rate of parasitism was about 17% in May. Stark and Acheampong (2007) reported that the cabbage aphid, *B. brassicae,* and the green peach aphid, *M. persicae* are both suitable hosts for the aphid parasitoid, *D. rapae.* They found that *D. rapae* prefers *B. brassicae* because it oviposits more frequently and produces a significantly higher percentage of progeny in *B. brassicae*. The functional response of *D. rapae* towards cabbage aphids was examined by Moayeri *et al*. (2013) in laboratory studies at three constant temperatures, 17°C, 25°C and 30°C. They reported that *D. rapae* exhibited a type II functional response at all three temperatures. Elliott *et al*. (2014) determined the parasitoid species attacking aphids in canola during the flowering through pod development growth stages when aphid populations often build to the point requiring insecticide treatment. *D. rapae* was the dominant parasitoid species. Data obtained from this manuscript is considered as a good informative background about the major insect pests infesting the cultivated canola cultivars in Egypt, their incidence, their relations with plant cultivars and their associated naturally occurring biological control agents.

Table 1. A partial taxonomic list of arthropods inhabiting three canola cultivars during 2017 and 2018 growing seasons at Assiut

Order & family	Scientific name	Status	Sampling method	Frequency
Thysanoptera				
Thripidae (Cotton/Onion thrips)	*Thrips tabaci* Lindeman	Phytophagous	Sweeping net	HF
Hemiptera-Heteroptera				
Pentatomidae (Stink bugs)	*Nezara viridula* (Linnaeus)	Phytophagous	Sweeping net	R
Anthocoridae (Minute pirate bugs)	*Orius* spp.	Predator	Sweeping net	R
Miridae (Plant bugs or leaf bugs)	*Campylomma impicta* Wagner	Predator	Sweeping net	F
Homoptera				
Aleyrodidae	*Bemicia tabaci* Lindeman	Phytophagous	Sweeping net	F
Cicadellidae (Leaf hoppers)	*Empoasca* spp.	Phytophagous	Sweeping net	F
Aphididae (Aphids)	*Brevicorine brassicae* L.	Phytophagous	Sweeping net & Direct count	HF
	Lipaphis erysimi (Kalrenbach)	Phytophagous	Sweeping net & Direct count	R
	Myzus percicae (Sulz)	Phytophagous	Sweeping net & Direct count	F
Coleoptera				
Staphylinidae (Horse show crab beetles)	*Paederusalfierii* Koch	Predator	Sweeping net	R
Coccinellidae (ladybird beetles)	*Coccinella undecimpunctata*L.	Predator	Sweeping net	R
	Scymnus interruptus Mars	Predator	Sweeping net	R
	Stethorus punctillum Weise	Predator	Sweeping net	R
Hymenoptera				
Aphididae	*Diaeretiella rapae* (McIntoch)	Parasitoid	Direct count	HF

F=Frequent HF=High Frequent R=Rare

Table 2. Dominance and abundance percentages of the major insect pests and associated natural enemies inhabiting three canola cultivars / 10 sweeping net double strokes* during 2017 growing season at Assiut

Taxon	Bactol cultivar				Serw4 cultivar				Serw 6 cultivar			
	Total numbers	D %	Presence	A%	Total numbers	D%	Presence	A%	Total numbers	D%	Presence	A %
Phytophagous species												
Brevicorine brassicae	3450	38.08	6	60	2590	36.15	6	60	2360	36.89	7	70
Myzus percicae	1230	13.58	4	40	895	12.49	2	20	788	12.32	3	30
Thrips tabaci	4380	48.34	10	100	3680	51.36	10	100	3250	50.79	10	100
Total	9060	95.59	-----	-----	7165	95.88	-----	-----	6398	96.04	-----	-----
Entomophagous species												
Mummified *B. brassicae*	380	90.91	7	70	280	90.91	6	60	240	90.91	6	60
Campylomma impecta	22	5.26	3	30	18	5.84	2	20	16	6.06	3	30
Coccinella undecimpunctata	16	3.83	2	20	10	3.25	1	10	8	3.03	1	10
Total	418	4.41	-----	-----	308	4.12	-----	-----	264	3.96	-----	-----
Grand Total	9478	100	-----	-----	7473	100	-----	-----	6662	100	-----	-----

***= Ten samples/season D=Dominance A=Abundance**

Table 3. Dominance and abundance percentages of the major insect pests and associated natural enemies inhabiting three canola cultivars / 10 sweeping net double strokes* during 2018 growing season at Assiut.

Taxon	Bactol cultivar				Serw 4 cultivar				Serw 6 cultivar			
	Total numbers	D %	Presence	A%	Total numbers	D%	Presence	A%	Total numbers	D%	Presence	A %
Phytophagous species												
Brevicorine brassicae	3680	35.49	8	80	2590	36.15	8	80	2388	39.87	8	80
Myzus percicae	1370	13.21	4	40	895	12.49	2	20	622	10.38	4	40
Thrips tabaci	5320	51.30	10	100	3680	51.36	10	100	2980	49.75	10	100
Total	10370	95.79	------	------	7165	95.44	------	------	5990	95.14	------	------
Entomophagous species												
Mummified *B.brassicae*	420	92.11	8	80	320	93.57	5	50	286	93.46	7	70
Campylomma impecta	26	5.70	4	40	14	4.09	2	20	14	4.58	4	40
Coccinella undecimpunctata	10	2.19	2	20	8	2.34	1	10	6	1.96	2	20
Total	456	4.21	------	------	342	4.56	------	------	306	4.86	------	------
Grand Total	10826	100	------	------	7507	100	------	------	6296	100	------	------

***= Ten samples/season D=Dominance A=Abundance**

Table 4. Mean numbers of *Brevicoryne brassicae* inhabiting canola plants during 2017 and 2018 growing seasons at Assiut.

Inspection date		Mean numbers of individuals / 1 Canola plant									Grand Mean
		Bactol cultivar			Serw 4 cultivar			Serw 6 cultivar			
		2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	
Feb.	5	92.66	86.55	89.61e	86.25	78.65	82.45c	85.69	72.36	79.03cd	83.70
	12	165.22	156.36	160.79c	122.56	111.58	117.07b	88.00	80.00	84.00	120.62
	19	166.22	182.98	174.60bc	142.96	112.68	127.82b	110.25	100.27	105.26b	135.89
	26	175.66	186.32	180.99ab	154.36	124.68	139.52ab	112.00	99.22	105.61b	142.04
March,	5	180.55	189.33	184.94a	166.86	132.25	149.56a	114.44	115.22	114.83a	149.78
	12	130.33	123.66	127.00d	110.22	89.36	99.79c	100.58	99.28	99.93c	108.91
	19	124.36	125.65	125.01d	99.69	76.98	88.34c	86.89	88.69	87.79c	100.38
	26	118.45	120.56	119.51d	88.23	68.65	78.44cd	77.98	78.65	78.32cd	92.09
Apr.,	2	116.36	118.25	117.31d	78.65	59.25	68.95cd	66.22	70.22	68.22d	84.83
	9	44.28	45.58	44.93f	33.56	23.56	28.56d	29.22	26.28	27.75de	33.75
Mean		131.41	133.52	132.47A	108.33	87.76	98.05B	87.13	83.02	85.08C	105.20
Susceptibility degree		Susceptible			Low Resistant			Moderately Resistant			

F value between cultivars= 15.34**

F value between dates= 33.92 28.20** 26.33****

Means followed by the same letter are not significantly different at 0.05 level of probability by Duncan's multiple range test

Table 5. Mean percentage of *Brevicoryne brassicae* parasitized by *Diaeretiella rapae* during 2017 and 2018 growing seasons at Assiut governorate

Inspection date	Mean no. of *B. brassicae* individuals / 1 Canola plant	Mean no. of mummified *B.brassicae* / 1 Canola plant	% Parasitism
Feb., 5	83.70	18.66	18.23
12	120.67	43.00	26.27
19	135.89	48.66	26.46
27	142.04	56.00	28.28
March, 5	149.78	89.66	37.45
12	108.91	72.00	39.80
19	100.38	72.33	41.88
26	92.09	66.25	41.84
Apr., 2	84.83	65.58	43.60
9	33.75	28.36	45.66
Mean	105.20	56.05	34.76

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ARABIC SUMMARY

العوامل الحيوية المسؤولة عن التحكم في أتجاه مجموع من الكرنب *Brevicoryne brassicae* L. الذي يقطن نباتات الكانولا

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أجريت الدراسة الحالية للتعرف علي التركيب النوعي و أتجاه مجاميع بعض الأفات من مفصليات الأرجل و الأعداء الحيوية التي تقطن زراعات الكانولا في أسيوط جنوبي مصر.تم تقدير الحساسية النسبية لنباتات الكانولا لمن الكرنب و تاثير المتطفلات الموجودة طبيعيا على أتجاه مجاميع هذه الأفة. أظهرت النتائج تواجد 14 نوع تتبع 14 جنس و 7 عائلات و 5 رتب حشرية. الأنواع المفترسة (*Campylomma impicta* Wagnerand *Coccinella undecimpunctata* L) شكلت الجانب الأكبر من الأنواع أكلات الحشرات بينما تمثلت الطفيلات بنوع واحد [*Diaeretiellar rapae* (Mclntoch)]. أظهرت الأنواع المفترسة 6% في الوفرة و 40% في السيادة. بينما أظهر طفيل المن *D. rapae* 90% من الوفرة و 60% من السيادة. تربس القطن *Thrips tabaci* كان أكثر الأفات تواجدا بينما أحتل من الكرنب المرتبة الثانية بنسبة أقل في الوفرة و السيادة. و قد أظهرت النتائج نشاط من الكرنب علي الكانولا طوال موسم النمو.أظهرت مجاميع المن أرتفاعا تدريجيا حتي ظهور القمة في 5 مارس في كلا موسمي الدراسة. تبع ذلك أنخفاضا تدريجيا في الأعداد حتي نهاية الموسم. ظهرت أعلي متوسطات لأعداد المن علي الصنف باكتول بمتوسط 132,47 فرد/نبات خلال موسمي الدراسة و تم تصنيفه كصنف حساس.أما صنفي الكانولا سرو4 و سرو 6 فقد أحتوت أعداد أقل من الأفة بمتوسط 98,05 و 85,05 فرد/ نبات و تم تسجيلهما كصنف منخفض المقاومة و صنف معتدل المقاومة علي التوالي. تم حساب معدل تطفل *D. rapae* علي من الكرنب. لوحظ أن معدل التطفل أستمر في الزيادة بالرغم من الأنخاض المستمر في أعداد المن حتي نهاية الموسم. و قد سجل المتوسط العام للتطفل 76,34%. تلازم أنخاض أعداد الأفة مع زيادة أعداد الطفيل تعتبر دليل علي مسؤولية الطفيل *D. rapae* كأحد عناصر المكافحة الحيوية التي يمكن أن تستخدم في التحكم في أعداد من الكرنب.

الكلمات الدالة: من الكرنب – أتجاه المجموع – أدارة الأفة – الحساسية النسبية- - الكانولا.