EGYPTIAN ACADEMIC JOURNAL OF

BIOLOGICAL SCIENCES

TOXICOLOGY & PEST CONTROL

F

ISSN
2090-0791

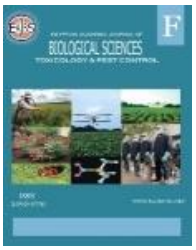
WWW.EAJBS.EG.NET

Vol. 12 No. 2 (2020)

Citation: *Egypt. Acad. J. Biolog. Sci. (F. Toxicology & Pest control) Vol. 12(2) pp.25- 34 (2020)*

Egypt. Acad. J. Biolog. Sci., 12(2): 25-34 (2020)

Egyptian Academic Journal of Biological Sciences
F. Toxicology & Pest Control
ISSN: 2090 - 0791
http://eajbsf.journals.ekb.eg/



Responsibility of Certain Biotic Factors for Management Populations of *Brevicoryne brassicae* L in Cabbage fields

Farouk A. Abdel-Galil [1], Safaa M.A. Amro[2], Abd El-Raheem A. Abd El-Raheem[1,] Dalya Y.A. Darwish[1] and Mervat A.B. Mahmoud[3]

1-Plant Protection Department, Faculty of Agriculture, Assiut University, Assiut, Egypt.
2-Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.
3-Zoology Department, Faculty of Science, South Valley University, Qena, Egypt.
E.mail : faagalil@hotmail.com, moamro1953@yahoo.com, arhim 67@gmail.com, dalia.darwish@agr.au.edu.eg, mervat.mahmoud@sci.svu.edu.eg

ARTICLE INFO

Article History
Received:9/6/2020
Accepted:30/8/2020

Key words:
Cabbage, aphid populations, relative susceptibility, parasitoids, yields loss.

ABSTRACT

This work was carried out at the experimental farm of the Faculty of Agriculture, Assiut University during the 2017-2018 and 2018-2019 cabbage growing seasons. Evaluation of the seasonal abundance of the cabbage aphid *Brevicoryne brassicae* L in cabbage fields and responsibility of certain biotic factors for managing populations of this insect pest was the cornerstone of this investigation. Cabbage aphid, *B. brassicae* was found to be active on cabbage plantations and recorded in low numbers (99.71 individuals / 12.5 Cm^2 / leaf / infested plant) at the beginnings of the season (November) with gradual increase until harvesting. Three amongst the six evaluated cabbage cultivars and/or hybrids were appeared as susceptible (S) and harbored so high numbers of the pest. However, the remaining cultivars showed some sort of resistance to this insect pest. The local cultivar (Ganzory) harbored the least aphid numbers and appeared as moderately resistant (MR) cultivar. This finding could be attributed to the antixenosis and/or antibiosis phenomena presented by this local cultivar. Proteins and amino acid contents showed a highly significant positive correlation (r) with *B. brassicae* populations, however, chlorophyll showed highly significant negative (r). The obtained data reflect the role of the cabbage aphid parasitoid *Diaeretiella rapae* (McIntosh) to manage *B. brassicae* populations. Mummified aphids (parasitism rate) before harvesting were found to be equal 6.16 fold of that recorded before ripening stages. High percentages of *D. rapae* were succeeded to emerge from the mummified *B. brassicae* with diverse extrusion rates. Multiple increases were recorded on the percentages of infested plants when cabbage undergo toward ripening at the 9^{th} stage till harvesting**.** No or less existence of unmarketable plants (through the periods of the low infestation) before cup formation and/or plant ripening period was recorded. So, it can be concluded that cabbage cultivar, plant age, and stage in addition to plant metabolites combined with the naturally occurring biological control agent (Aphid parasitoid) can be affected and manage the population trend of cabbage aphid *B. brassicae* infesting cabbage in the field.

INTRODUCTION

Cabbage (*Brassica oleracae* var. *capitata* L.) is an herbaceous green leafy vegetable belonging to the *Brassica* genus, of the Brassicaceae family with several other

crop species including broccoli, cauliflower, kale and kohlrabi (Katz and Weaver, 2003). It is an excellent source of a variety of vitamins, minerals and dietary fibre (Adeniji *et al*.,2010), and has been ranked by the Food and Agriculture Organization (FAO) among the top twenty vegetable crops grown worldwide, which establishing as an important food source globally (FAO, 1988).

Cabbage plantations have been subjected to attack by severe key insect pests especially the aphid *Brevicoryne brassicae* (Linnaeus) (Homoptera: Aphididae). Aphids damaged cabbage both directly and indirectly. The feeding of adults and nymphs harms plants directly, while indirect damage can result from the secretion of honeydew, the transmission of plant diseases, and the contamination of the harvested crop (Liu and Sparks, 2001). A high proportion of studies were concerned with the cabbage insect pest management by using entomophagous parasitoids. The hymenopteran parasitoid *Diaeretiella rapae* (McIntosh) (Hymenoptera: Aphidiidae) is a highly polyphagous parasitic wasp parasitizing exclusively aphids throughout the world infesting hundreds of plant species, both cultivated and wild (George, 1957). Seasonal abundance of *B. brassicae* and *D. rapae* was evaluated by Duchovskienė and Raudonis, (2008) in Lithuania. However, the efficacy of the aphid parasitoid *D. rapae* to control *B. brassicae* was clarified by Saleh (2014) in Egypt. Damage and host plant resistance was previously studied by several investigators e.g. McLaren (1975) in New Zealand and Munthali (2009) in Botswana.

The main goal of the current study is to determine the seasonal abundance of the cabbage aphid *B. brassicae* on certain local and imported cabbage cultivars and/or hybrids with reference to the impact of certain cabbage metabolites on *B. brassicae* populations. Relative susceptibility of the tested cabbage cultivars against *B. brassicae* was investigated. The parasitism rate and natural emergence of the aphid parasitoid *D. rapae* were calculated. Yield loss was in consideration.

MATERIALS AND METHODS

Experiments were carried out at the experimental farm of the Faculty of Agriculture, Assiut University during 2017-2018, and 2018-2019 cabbage growing seasons at (ca.1050m2.) /each. The experimental area was divided into plots (10.5 m2 / plot). Six local and newly imported cabbage cultivars and hybrids (Table 1) were obtained from El-Salam arboretum and RIJK ZWAAN Company. Cabbage cultivars were cultivated in on the 3rd September, in both seasons. One month later, cabbage plants were transplanted to the sustainable farm and cultivated (at 50Cm intervals) at a completely randomized block design between the tested cultivars. Regular conventional agricultural practices (irrigation and fertilization) were normally performed and insecticides were completely prevented.

Table1. The evaluated cabbage cultivars

Trade name	Country of origin	Imported by	Producer
1- Cabbage Cultivar Ganzory	Egypt	Local Cultivar	El-Salam Arboretum
2- Cabbage Hybrid Kenz	Italy	Techno green Co.	Rijk Zwaan- Holland
3- Cabbage Hybrid Crossina	Japan	Fine seeds Int. SAE	Rijk Zwaan- Holland
4- White Cabbage Hybrid 728	Chile	Fine seeds Int. SAE	Rijk Zwaan- Holland
5- White Cabbage Hybrid 730	Chile	Fine seeds Int. SAE	Rijk Zwaan- Holland
6- White Cabbage Hybrid 747	Germany	RZ Egypt LLC	Rijk Zwaan- Holland

Seasonal Abundance of the Cabbage Aphid, *B. brassicae*:

The direct count method was used to record numbers of the aphid *B. brassicae* inhabiting the outer cabbage leaves at weekly intervals as used by Varmora *et al* (2009); Yuliadhi *et al*. (2015); Salem *et al*. (2018). Four cabbage leaves (1 leaf / plant) / each replicate (4 replicates) / each cultivar were randomly picked up from 4 infested cabbage plants and transferred to the laboratory to later examination. Mean numbers of *B. brassicae* (live and mummified) were counted / 12.5 Cm^2 / leaf, 47 days post-plantation until harvesting.

Relative Susceptibility of Cabbage Cultivars to *B. brassicae:*

To determine the relative susceptibility of the tested cabbage cultivars to the cabbage aphid *B. brassicae*, the following procedure was used:

Numbers of *B. brassicae* were visually counted on 12.5 Cm^2/leaf/plant/cultivar in the laboratory by the abovementioned direct count method at weekly intervals. Mean numbers of *B. brassicae* were used to determine the relative susceptibility degrees of the tested cabbage cultivars as described by Chiang and Talekar (1980) equation. Relative susceptibility degree was dependent on the general mean number of the pest $\bar{X}$ and the standard deviation (SD). Cultivars that had mean numbers more than $\bar{X}$ +2SD, were considered highly susceptible (HS); between $\bar{X}$ and $\bar{X}$ +2SD, susceptible (S); between $\bar{X}$ and $\bar{X}$ -1SD, low resistant (LR); between $\bar{X}$ -1SD and $\bar{X}$- 2SD, moderately resistant (MR) and less than $\bar{X}$ -2SD, were considered highly resistant (HR) cultivars. To confirm the results obtained by using the abovementioned equation; soluble proteins, total free amino acids, soluble sugars were determined calorimetrically according to procedures described by Lowry *et al.* (1951), Lee and Takahashi (1966) and Dubois *et al.* (1956), respectively. The content of each metabolite in the studied plant was expressed in mg.g-1 dry weight. Chlorophyll content index (CCI) was measured and calculated using chlorophyll content meter (Opti-sciences CCM 200, USA) as described by Debra and Daniel (2012). The reading of CCI was taken as an average of different 5 leaves (5 plants) from each genotype. The correlation coefficient between the aforementioned plant soluble primary metabolites and the seasonal abundance of *B. brassicae* has been estimated.

Natural and Successful Parasitism Rates of *D. rapae* on Cabbage Aphid *B. brassicae*:

1- Natural Parasitism Rates in the Field:

The natural parasitism rates of *D. rapae* parasitized the cabbage aphid *B. brassicae* infesting cabbage in the field was determined weekly by estimating the number of live and mummified aphid on the selected leaves. Later parasitoid identification in the laboratory by the specialists in the taxonomy department in the Plant Protection Research Institute (ARC) was established. Parasitism percentage was estimated by the equation used by Puneeth and Vijayan (2014) as follow:

Parasitism %= number of parasite (mummified) aphids/ Total number of aphids× 100

2- Successful Parasitism Rates in the Laboratory:

To measure the successful parasitism rate, 25 mummified individuals were kept in test tubes (4 replicates) at laboratory conditions

(22±3°C and 60±5 R.H. %) and covered with a small piece of moistened cotton to keep appropriate moisture levels. Successful parasitism rate was estimated by dividing numbers of emerged parasitoids on the initial number of mummified aphids and multiplying the resulted number X100.

Damage and Yield Loss:

Damage percentage (infested and unmarketable) plants caused by *B.brassicae* attacking the tested cabbage cultivars were determined by the direct count in the field at weekly intervals. Damage percentage can estimate by the following equation as follows:

Damage %= Number of damaged cabbage plants/ Total number of cabbage Plants× 100

Data were statistically analyzed by using F-test and means were compared according to Duncan's multiple range tests as described by Steel and Torrie (1982).

RESULTS AND DISCUSSION

Seasonal Abundance of the Cabbage Aphid, *B. brassicae* :

Data presented in Table (2) expressed about the monthly seasonal abundance of cabbage aphid *B. brassicae* infesting the tested cabbage cultivars in Assiut during 2017-2018 and 2018-2019 growing seasons. This insect pest was found to be active on cabbage plantations and recorded in low numbers at the beginnings of the season (99.71 individuals / 12.5 Cm^2 / leaf) in November when plants age are in 47-54 days old and fifth-sixth stages. The gradual increase was recorded until the appearance of its peak (229.64 individuals / 12.5 Cm^2 / leaf) during January when plants were in 89-117 days old and ninth stage. Quietly decline was recorded until the end of the season in February. The imported cabbage hybrid Kenz harbored the highest pest numbers with an average of 222.85 individuals / 12.5 Cm^2 / leaf and constituted 1.44-fold of those infesting the local cultivar Ganzory by (154.26 individuals / 12.5 Cm^2 / leaf). It is important to note that, the local cultivar (Ganzory) harbored fewer numbers than all of the imported hybrids which varied significantly in harboring *B. brassicae*. Factors responsible for this finding could be attributed to the presence of its required nutrients in a particular cultivar than the others. Highly variations were recorded between inspection months, as well as, the tested cultivars infestation (f=679.63** and 89.19**), respectively. a similar study in Pakistan, Jatoi *et al.* (2001), reported that the native cabbage variety Golden acre attracted the least number of *B. brassicae*, but the number was not statistically different from the others tested cultivars.

Table 2: Seasonal abundance of cabbage aphid, *Brevicoryne brassicae* inhabiting cabbage plants in Assiut during 2017-2018 and 2018 -2019 growing seasons**.**

Inspection month	Plant		Mean no. / 12.5 Cm^2 / leaf / cabbage cultivar						Mean
	Age (Days)	Stage	Kenz	Crossina	Ganzory	WCH 728	WCH 730	WCH 747	
Nov.2017&18 (2)	47-54	5-6	114.33 l	108.81 lm	67.73 n	97.30 m	102.13 lm	107.97 lm	99.71 C
Dec. 2017&18 (4)	61-82	7-9	262.52 b	245.89 c	165.25 k	186.29 j	196.55 ghij	212.93 defg	211.57 B
Jan. 2018 &19 (5)	89-117	9	285.93 a	257.79 bc	194.78 hij	204.61 fghi	210.50 efgh	224.22 de	229.64 A
Feb. 2018 &19 (4)	124-145	9	228.64 d	218.45 def	189.30 ij	203.16 fghi	206.40 fgh	210.98 efgh	209.49 B
Mean			222.85 A	207.74 B	154.26 E	172.84 D	178.89 D	189.03 C	187.60
Susceptibility Degree			S	S	MR	LR	LR	S	

WCH=White Cabbage Hybrid ( ) No of monthly samples S=Susceptible LR= Low Resistant MR= Moderately Resistant F value: Between months= 769.63** ; Between cultivars= 89.19**; Months × Cultivars = 7.46** Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests.

Relative Susceptibility of Cabbage Cultivars to *B. brassicae*:

According to *B. brassicae* mean numbers and the standard deviation previously clarified in Table (2), the susceptibility degrees of the six tested cabbage cultivars and / or hybrids were grouped into three categories. Data revealed high variations between the tested cultivars. Three amongst these cultivars were appeared as susceptible (S) cultivars (hybrids) and harbored so high numbers of the pest. However, white cabbage hybrids, 728, and 730 appeared as low resistant hybrids (LR) and harbored 172.84 and 178.89

individuals / 12.5 Cm^2 / leaf. On the other hand, the local cultivar (Ganzory) showed some sort of resistance and appeared as moderately resistant (MR) cultivar and harbored the lest aphid number with an average of 154.26 individuals /12.5 Cm^2 / leaf. Correlations between cabbage metabolites and *B. brassicae* populations were clarified in Table (3). It is clear that proteins and amino acid contents showed a highly significant positive correlation (r = 0.920** and 0.921**, respectively) with *B. brassicae* populations. However, chlorophyll showed highly significant negative correlation (r = -0.962**). Note that, the imported hybrid (Kenz) contains the highest protein content (32.11 mg/g dry wt.) and moderately low chlorophyll (16.23 SPAD) and consequently harbored the highest *B. brassicae* populations (222.85 individuals / 12.5 Cm^2 / leaf). Conversely, the local cultivar (Ganzory) contains the least protein content (16.77 mg/g dry wt.) and relatively high chlorophyll (32.53 SPAD) and consequently harbored the lowest *B. brassicae* populations (154.26 individuals / 12.5 Cm^2 / leaf). This finding could be attributed to the antixenosis and/or antibiosis phenomena presented by this local cultivar. In this respect, antixenosis of 12 genotypes of cabbage (*Brassica oleracea* var. *capitata*) against *B. brassicae* was studied by Jatoi *et al*. (2001) in Pakistan. They reported that 5 genotypes attracted more number of aphids and the aphid thus showed more preference on these genotypes as compared to the others. Chlorophyll, water, and protein content and leaf thickness were estimated and their effects on aphid abundance and damage intensity were determined by Munthali and Tshegofatso (2014). They reported that breeding for low protein and water content, high chlorophyll content, and thin leaves are recommended because the cultivar produced would suffer low honeydew damage.

Table 3. Correlation coefficient between some plant soluble primary metabolites and the seasonal abundance of cabbage aphid *Brevicoryne brassicae* in Assiut during 2017-2018 and 2018-2019 growing seasons.

Cabbage cultivars (Hybrids)	Aphid mean no./ 12.5 Cm^2 / leaf	Proteins Mg/g Dry wt.	Amino Acids Mg/g Dry wt.	Nitrogen Mg/g Dry wt.	Sugars Mg/g Dry wt.	Chlorophyll SPAD
Kenz	222.85	32.11	13.95	2.23	124.24	16.23
Crossina	207.74	28.81	12.38	1.98	139.02	17.03
Ganzory	154.26	16.77	4.27	0.68	54.17	32.53
WCH 728	172.84	25.08	10.25	1.64	107.23	25.93
WCH 730	178.89	26.55	8.96	1.43	108.26	24.63
WCH 747	189.03	27.00	11.47	1.83	141.33	20.57
r value		**0.920****	**0.921****	**0.921****	**0.753**	**-0.962****

WCH=White Cabbage Hybrid

Natural and Successful Parasitism Rates of *D. rapae* on Cabbage Aphid *B. brassicae*:

1- Natural Parasitism rates in the Field:

As known, mummified aphid numbers refer to the parasitoid populations (parasitism rate). So, data in Table (4) expressed about mean percentages of mummified aphid *B. brassicae* parasitized by *D. rapae* in cabbage fields in Assiut during 2017-2018 and 2018-2019 growing seasons. Data revealed that *D. rapae* was recorded in active status at the beginnings of the season (11.76% mummified aphids / 12.5 Cm^2 / leaf) at November. Continues increase in mummified aphid percentages was recorded until the end of the season at February with an average of 72.15% mummified aphid / 12.5 Cm^2 / leaf. Note that, mummified aphids% (parasitism rate) at the last inspection month (when plants age are in 124-145 days old and ninth stage) was found to be equal 6.16 fold of that recorded in the first inspection month (when plants age are in 47-54 days old and fifth-sixth stages). Simultaneous increase of mummified aphids led to highly significant variation between the inspection months (F=11286.77**). The seasonal mean percentages

of mummified aphids inhabiting the tested cabbage cultivars ranged between 32.59% on the imported white cabbage hybrid (730) and 34.06 % on the imported white cabbage hybrid (Kenz). Highly significant variations were recorded between the tested cultivars ($F=3.86^{**}$). Seasonal fluctuations in population density of the cabbage aphid *B. brassicae* and the role of its parasite *D. rapae* to suppress its populations have been studied worldwide by several authors e.g. Boyd and Lentz (1994) in USA. ; Saleh *et al*. (2009) in Egypt, and it has been observed to cause as high as 72% parasitism in the Netherlands (Hafez, 1961) and 76% parasitism in Kenya (Bahana and Karuhize, 1986). In a similar study, and different circumstances (in Lithuania) conversable results were obtained by (Duchovskienė and Raudonis, 2008). They reported that, the highest parasitism rate of *D.rapae* on *B. brassicae* was observed in the periods when the number of aphids on the plants was the lowest, at the end of their occurrence on the plants.

Table 4: Mean percentages of mummified aphid *Brevicoryne brassicae* parasitized by *Diaeretiella rapae* in cabbage fields in Assiut during 2017-2018 and 2018-2019 growing seasons.

Inspection month	Plant		Mean percentage of mummified aphid / 12.5 Cm2 / leaf / cabbage cultivar						Mean
	Age (Days)	Stage	Kenz	Crossina	Ganzory	WCH 728	WCH 730	WCH 747	
Nov. 2017&18 (2)	47-54	5-6	15.29 d	12.28 efg	11.94 fgh	10.88 gh	10.00 h	10.18 h	11.76 D
Dec. 2017&18 (4)	61-82	7-9	12.56 efg	14.20 de	13.75 def	13.34 def	13.50 def	13.20 ef	13.43 C
Jan. 2018 &19 (5)	89-117	9	36.60 c	35.69 c	35.01 c	34.98 c	35.43 c	36.50 c	35.70 B
Feb. 2018 &19 (4)	124-145	9	71.79 b	72.07 b	74.63 a	71.47 b	71.43 b	71.52 b	72.15
Mean			34.06 A	33.56 ab	33.83 A	32.66 B	32.59 B	32.85 B	33.26

WCH=White Cabbage Hybrid ( ) No of monthly samples

F value: Between months= 11286.77**; Between cultivars= 3.86**; Months × Cultivars = 3.60**

Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests.

2- Successful Parasitism Rates in the Laboratory:

Mean percentages of *D. rapae* emerged from the mummified aphid *B. brassicae* that transferred to the laboratory was calculated in Table (5). High percentages of *D. rapae* were succeeded to emerge from the mummified *B. brassicae* with diverse extrusion rates. Dependent on the variations between the monthly temperatures, 82.75% of *D. rapae* was succeeded to emerge from the mummified aphids during November. Continuous decrease in temperatures caused an obvious decline in the emerged *D. rapae* percentages with an average of 78.83 and 66.00 emergence % during December and January, respectively. It is clear that parasitoid emergence during the beginning (November) and the end of the season (February) was found to be equal 1.25 and 1.20 fold of that recorded during mid-season (January), respectively. High variations were recorded between inspection months (f=116.45**). This finding could be attributed to the temperature which recorded its lowest levels during January. Dependent on the tested cultivars, the successful parasitism rate showed high significant variations (F=16.46**). Performance of the parasitoid species *D. rapae* for controlling *B. brassicae*, *Aphis craccivora* (Koch), and *Aphis nerii* Boyer infesting cabbage, faba bean, and oleander plants was clarified by Saleh (2014). His obtained results revealed that with the increase of parasitoid density the fecundity of the parasitoid *D. rapae* increased (as a number of mummies and emerged adults increased).

Table 5: Mean percentages of emerged parasitoid *Diaeretiella rapae* parasitized on the cabbage aphid, *Brevicoryne brassicae* in cabbage fields in Assiut during 2017-2018 and 2018-2019 growing seasons.

Inspection month	Plant		% emerged parasitoids / 25 mummified aphid / cabbage cultivar						Mean
	Age (Days)	Stage	Kenz	Crossina	Ganzory	WCH 728	WCH 730	WCH 747	
Nov. 2017&18 (2)	47-54	5-6	83.25 a	83.25 a	77.75 bc	84.00 a	84.75 a	83.50 a	82.75 A
Dec. 2017&18 (4)	61-82	7-9	75.63 cd	77.50 bc	73.38 cd	83.13 a	82.38 ab	81.00 ab	78.83 B
Jan 2018 &19 (5)	89-117	9	71.30 de	67.60 e	56.00 g	62.00 f	67.10 e	72.00 de	66.00 C
Feb. 2018 &19 (4)	124-145	9	85.50 a	83.00 a	74.25 cd	73.88 cd	75.63 cd	82.25 ab	79.08 B
Mean			78.92 A	77.84 AB	70.34 C	75.75 B	77.46 AB	79.69 A	76.67

WCH=White Cabbage Hybrid ( ) No of monthly samples

F value: Between months = 116.45**; Between cultivars = 16.46** ; Months × Cultivars =4.66**

Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests.

Damage and Yield Loss:

1- Infested Plants:

Mean percentages of cabbage plants infested by the cabbage aphid *B. brassicae* in cabbage fields during the 2017-2018 & 2018-2019 growing seasons were calculated and presented in Table (6). Data revealed that the lowest infestation percentage was recorded during November at the plant age of 47-54 days old and 5-6 growing stages with an average of 2.88 % infested plants/plot. Multiple increases were recorded when cabbage undergo toward ripening at the 9th stage till harvesting with average percentages of 8.58, 16.05, and 33.34% infested plants/plot during December, January, and February, respectively. Data revealed that the percentage of infested plants at the harvesting period was equal to 11.58 fold of that recorded before the ripening period. Regarding the tested cabbage cultivars, the highest infestation percentage was recorded on Kenz hybrid, with an average of 20.12 % infested plants/plot, while the lowest infestation percentage was recorded on Ganzory cultivar with an average of 9.14 % infested plants/plot. Highly significant variation between the inspection months and between the tested cultivars was recorded (F=1283.71** and 73.87**, respectively).

Table 6: Mean percentages of cabbage plants infested by the cabbage aphid *Brevicoryne brassicae* in cabbage fields in Assiut during 2017-2018 and 2018-2019 growing seasons.

Inspection month	Plant		% infested plants / plot (10.5 m^2) / cabbage cultivar						Mean
	Age (Days)	Stage	Kenz	Crossina	Ganzory	WCH 728	WCH 730	WCH 747	
Nov. 2017&18 (2)	47-54	5-6	4.12 i	3.41 i	1.69 i	2.40 i	2.40 i	3.23 i	2.88 D
Dec. 2017&18 (4)	61-82	7-9	10.46 g	10.04 gh	3.71 i	8.56 gh	8.61 gh	10.11 gh	8.58 C
Jan 2018 &19 (5)	89-117	9	21.83 e	17.05 f	7.46 h	15.76 f	16.11 f	18.11 f	16.05 B
Feb. 2018 &19 (4)	124-145	9	44.08 a	39.88 b	23.71 e	27.37 d	27.74 d	37.28 c	33.34 A
Mean			20.12 A	17.60 B	9.14 D	13.52 C	13.71 C	17.18 B	15.21

WCH=White Cabbage Hybrid ( ) No of monthly samples

F value: Between months = 1283.71** ; Between cultivars = 73.87** ; Months × Cultivars = 14.57**

Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests.

2- Unmarketable Plants:

Mean percentages of unmarketable cabbage plants infested by the cabbage aphid *B.brassicae* in cabbage fields during 2017-2018 & 2018-2019 growing seasons was calculated and presented in Table (7). According to the fact that unmarketable plants constitute a proportion of the infested plants, the obtained results revealed no or less

presence of unmarketable plants before cup formation and/or plant ripening period through the periods of low infestation. Until January, acceptable or not economic yield loss was recorded with an average of 5.73% unmarketable plants/plot. In February, when plants at 124-145 days old and 9th stage (complete ripening), percentages of unmarketable cabbage plants reach to 22.80%. So, harvesting cabbage plants at the beginnings of the ripening period could increase the yield income by more than 15%. Regarding the tested cabbage cultivars, the highest unmarketable cabbage plants percentage was recorded on Kenz hybrid (10.23 % unmarketable plants/plot), while the lowest unmarketable percentage was recorded on Ganzory cultivar with an average of 3.35 % unmarketable plants/plot. Highly significant variation between the inspection months and between the tested cultivars was recorded (F= 178.63** and 5.94**, respectively).

The advantages of the results obtained during this work were documented by Sharma (2015) results who evaluated the population of *B. brassicae*, plant infestation, and yield of marketable cabbage heads. His work was initiated on population and infestation commenced with the onset of pest activity at weekly intervals until plant infestation reached 20 to 25 percent. Existence of positive correlation between yield of marketable cabbage heads and aphid populations/plant infestations led to recommend controlling late aphid infestations and avoided against early aphid infestations.

So, it can be concluded that cabbage cultivar, plant age, and stage in addition to plant metabolites combined with the naturally occurring biological control agent (Aphid parasitoid) can be affected and manage the population trend of cabbage aphid *B. brassicae* infesting cabbage in the field.

Table 7: Mean percentages of unmarketable cabbage plants infested by the cabbage aphid *Brevicoryne brassicae* in cabbage fields in Assiut during 2017-2018 and 2018-2019 growing seasons**.**

Inspection month	Plant		% unmarketable plants / plot (10.5 m²) /cabbage cultivar						Mean
	Age (Days)	Stage	Kenz	Crossina	Ganzory	WCH 728	WCH 730	WCH 747	
Nov. 2017&18 (2)	47-54	5-6	0.00 e	0.00 e	0.00 e	0.00 e	0.00 e	0.00 e	0.00 D
Dec. 2017&18 (4)	61-82	7-9	2.75 cde	2.51 de	1.46 de	2.10 de	2.23 de	2.45 de	2.25 C
Jan 2018 &19 (5)	89-117	9	6.71 cd	6.19 cd	3.31 cde	5.50 cde	5.89 cde	6.78 cd	5.73 B
Feb. 2018 &19 (4)	124-145	9	31.46 b	29.94 a	8.62 c	21.16 b	21.11 b	24.49 b	22.80 A
Mean			10.23 A	9.66 a	3.35 B	7.19 A	7.31 A	8.43 A	7.70

WCH=White Cabbage Hybrid ( ) No of monthly samples

F value: Between months =178.63**; Between cultivars =5.94**; Months × Cultivars = 3.52**

Averages having the same letter are not significant at 5% level according to Duncan's multiple range test

Acknowledgment

We would like to show our gratitude to Prof. Dr. Mohammed A. Amro Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt, for his valuable and insightful comments reviewing an early version of this article.

REFERENCES

Adeniji, O.T.; Swai, I.; Oluoch, M.O.; Tanyongana, R. and Aloyce, A. 2010. Evaluation of head yield and participatory selection of horticultural characters in cabbage (*Brassica oleraceae* var. *Capitata* L.). *Journal of Plant Breeding and Crop Sciences*, 2(8): 243-250.

Bahana, J. and Karuhize, G. 1986. The role of *Diaeretiella rapae* (M'Intosh) (Hym: Braconidae) in the population control of the cabbage aphid, *Brevicoryne brassicae* L. (Hem.: Aphididae) in Kenya. *Insect Science and Its Application*,7, 605-609

Boyd, M.L. and Lentz, G.L. 1994. Seasonal incidence of aphids and the aphid parasitoid *Diaeretiella rapae* (M'Intosh) (Hym.: Aphidiidae) on rapeseed in Tennessee. *Environmental Entomology,* 23: 349-353.

Chiang, H. S. and Talekar, N. S. 1980. Identification of sources of resistance to the bean fly and two other Agromyzid flies on soybean and mungbean. *Journal of Economic Entomology,* 73 (2): 197-199.

Debra, M. and Daniel, M. 2012. Chlorophyll content. In: Physiological Breeding II: Alistair Pask, Julian Pietragalla, Debra M. and Matt H. R. (Eds.). *International Maize and wheat improvement center*, pp 41-43.

Dubois, M.; Gilles, K.A.; Hamilton, K.; Rabers, P.A. and Smith, F. 1956. Colorimetric method for the determination of sugars and related substances. *Analytical Chemistry*, 28: 350-356.

Duchovskienė, L. and Raudonis, L. 2008. Seasonal abundance of *Brevicoryne brassicae* L. and *Diaeretiella rapae* (M'Intosh) under different cabbage growing systems. *Ekologija,* 54. (4): 260–264.

FAO. 1988. Traditional Food Plants. Food and Agricultural Organisation of the United Nations, Rome, Italy, 8.

George, K.S. 1957. Preliminary investigations on the biology and ecology of the parasites and predators of *Brevicoryne brassicae* (L.). *Bulletin of Entomological Research,* 48: 619-629.

Hafez, M.1961. Seasonal fluctuations in population density of the cabbage aphid *Brevicoryne brassicae* (L.) in the Netherlands, and the role of its parasite *Aphidius* (*Diaeretiella*) rapae (Curtis). *Tijdsch. Pl.-ziekten, Nederlands,* 67:445-548.

Katz, S. H. and Weaver, W.W. 2003. *Encyclopedia of Food and Culture.* 2: 279-285.

Liu, T. X. and Sparks, Jr, A. N. 2001. Aphids on cruciferous crops identification and management. Rese. Entomol. and Extension Entomologist. The Texas A&M Univ. System.11 pp.

Lee, Y.P. and Takahashi, T. 1966. An important colorimetric determination of amino acids with the use of ninhydrine. *Analytical Biochemistry,* 14: 71-77.

Lowry, C. H.; Rosebrough, N. J.; Far, A. L. and Randall, R. J. 1951. Protein measurement with the folin phenol reagent. *Journal of Biological Chemistry,* 193:256-272.

McLaren, G. F. 1975. The population dynamics of the cabbage aphid, *Brevicoryne brassicae* (L.), in Central Otago, New Zealand. Thesis Lincoln College, University of Canterbury.

Jatoi, M. Y.; Asalam, M.; Misbah-UL-Haq and Ahmes, S.2001.Antixenosis of *Brevicoryne Brassicae* on different genotypes of cabbage (*Brassica oleracea* var. *capitata*). *Journal of Biological Sciences,* 1(7):621-622.

Munthali, D.C. 2009. Evaluation of cabbage varieties for resistance to the cabbage aphid. *African Entomology,* 17(1):1-7.

Munthali, D. C and Tshegofatso, A. B. 2014. Factors affecting abundance and damage caused by cabbage aphid, *Brevicoryne brassicae* on four brassica leafy vegetables: *Brassica oleracea* var. *acephala, B. chinense, B. napus* and *B. carinata*. *The Open Entomology Journal,* 8: 1-9.

Puneeth, P. and Vijayan, V. A. 2014. Parasitization capacity of *Trichogramma chilonis* ishii (Hymenoptera:Trichogrammatidac) on the eggs of *Helicoverpa armigera* (Lepidoptera:Noctuidae) under laboratory conditions. *International Journal of Science and Nature,* 5(3):462-465.

Saleh, A. A. 2014. Efficacy of the aphid parasitoid *Diaeretiella rapae* (M'intosh) to control *Brevicoryne brassicae* L., *Aphis craccivora* (koch) and *Aphis neriiboyer* at

Sharkia governorate, Egypt. *Egyptian Journal of Agricultural Research*, 92 (1):21-31.

Saleh, A. A.; Desuky, W.M.; Hashem, H.H. and Gatwarry, W.G. 2009. Evaluating the role of *Diaeretiella rapae* (M'Intosh) (Hymenoptera: Aphidiidae) parasitizing the cabbage aphid, *Brevicoryne brassicae* L. (Homoptera: Aphididae) at Sharkia Governorate, Egypt. *Egyptian Journal of Biological Pest Control*, 19(2): 151-155.

Salem, A. A.; Amro, M. A.; Abdel-Moniemb, A. S. H. and Abdel-Galil Y. M. A. 2018. Determination the population trends of cereal aphids and associated parasitoids by yellow sticky traps with reference to aphid management on wheat. *Archives of Phytopathology and Plant Protection*, 1034-1042.

Sharma, S. K. 2015. Influence of *Brevicoryne brassicae* L. incidence on the yield of marketable cabbage heads under different insecticide spray regimes in highlands of Himachal Pradesh (India). Bangladesh Journal of Botany, 44(3): 351-358.

Steel, R. G. D. and Torrie, J. H. 1982. Principals and Procedures of Statistics. A Biometrical Approach, McGraw-Hill Book Co.

Varmora, J. M.; Raghvani, K.L.; Joshi, M.D.; Makadia, R. R.; Dalwadi, N.G. and Boricha, H.V. 2009. Population dynamics of aphid, *Lipaphis erysimi* (Kalt.) and predators on cabbage. *Asian Sciences*, 4 (1): 56-58.

Yuliadhi, K.; Wayan, I. S.; Wijaya, I. N. and Pudjianto. 2015. The population succession patterns of cabbage main pest *Plutella xylostella* L. and *Crocidolomia pavonana* Fab at cabbage plantation. *International Journal of Biosciences and Biotechnology*, 3 (1):1-4.

ARABIC SUMMARY

مسؤولية بعض العوامل الحيوية عن التحكم في مجاميع حشرة المن في حقول الكرنب

فاروق عبد القوى عبد الجليل[1], صفاء محمد عبدالرحمن عمرو [2] عبد الرحيم أحمد عبد الرحيم [2]
, داليا يوسف عوض درويش[1]و مرفت أحمد بدوي محمود[3]

1- قسم وقاية النبات – كلية الزراعة – جامعة أسيوط
.2-معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – الجيزة – مصر
3- قسم علم الحيوان- كلية العلوم- جامعة جنوب الوادي – قنا - مصر

أجري هذا العمل في مزرعة كلية الزراعة جامعة أسيوط خلال موسمي زراعة الكرنب 2017-2018 و2018-2019. الهدف الأساسي لهذا العمل هو تقدير الوفرة الموسمية لحشرة من الكرنب Brevicoryne *brassicae* L. في حقول الكرنب ومسؤولية بعض العوامل الحيوية عن التحكم في مجاميع هذه الأفة الحشرية في الحقل. أظهرت هذه الأفة نشاطا في زراعات الكرنب حيث سجلت بأعداد قليلة بمتوسط 99.71 فرد/ 12,5 سم2 / ورقة / نبات مصاب في بداية الموسم خلال شهر نوفمبر مع زيادة تدريجية في الأعداد حتى فترة الحصاد. أظهرت النتائج أن ثلاثة أصناف ضمن الستة أصناف المختبرة ظهرت كأصناف حساسة للأصابة بالأفة بينما أبدت بقية الأصناف المختبرة درجة من المقاومة. الصنف المحلي (جنزوري) ظهر كصنف معتدل المقاومة. النتيجة المتحصل عليها تفيد بشأن هذا الصنف المحلي قد يظهر صفة عدم التفضيل أو التضاد الحيوي لهذة الأفة. أظهر المحتوي البروتيني ومحتوي الأحماض الأمينية أرتباط موجب معنوي جدا مع مجاميع حشرة من الكرنب بينما أظهر محتوي النبات من الكلوروفيل أرتباط سالب معنوي جدا مع مجاميع الحشرة. النتائج المتحصل عليها عكست دور الطفيل *Diaeretiella rapae* (McIntosh)في التحكم بمجاميع المن حيث نجحت نسبة كبيرة من هذا الطفيل في الأنبثاق من أفراد المن المتطفل عليها بنسب مختلفة .كما بلغت نسبة التطفل عند الحصاد 6.16 مرة من نسبته في بداية الموسم. أظهرت النتائج تزايد متضاعف في نسبة النباتات المصابة بتقدم عمر النبات نحو مرحلة النضج. خلال الفترة الأولي لنمو النبات عندما كانت الأصابة بحشرة المن قليلة لم تتواجد أي نسبة من النباتات غير الصالحة للبيع. و بهذا يمكن أن نستخلص من هذا العمل أن أصناف الكرنب وعمر ومرحلة نمو النبات بالأضافة لمحتوي النبات من العناصر الغذائية متحدة مع الأعداء الحيوية المتواجدة في الطبيعة يمكن أن يكون لها دور مؤثر في أتجاه مجاميع من الكرنب*B. brassicae* الذي يصيب الكرنب في الحقل .