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BEMISIA TABACI BIOTYPE Q (HOMOPTERA : ALEYRODIDAE) AND ITS PARASITOID, *ERETMOCERUS MUNDUS* (MERCET) (HYMENOPTERA : APHELINIDAE) ON SQUASH AND SOME CONTROL MEASURE

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ABSTRACT

Bemisia tabaci (Gennadius) (Homoptera : Aleyrodidae) Q-biotype it was recorded during the last two years as a new pest on squash in Egypt. The present study dealt with the abundance of *B. tabaci* Biotype Q and its parasitoid *Eretmocerus mundus* (Mercet) (Hymenoptera : Aphelinidae) on squash plants during 2006 and 2007 in Qalyoubia Governorate, Egypt. The effect of some natural compounds to control this pest was also studied. Population of *B. tabaci* reached maxima of 6475 and 6001 individuals/ 30 inch², during 2006 and 2007 seasons, respectively. Also during this work, 125 and 102 individuals / 30 inch² of leaves of *E. mundus* were recorded during 2006 and 2007 seasons, respectively. KZoil was the most effective compound against the stages of *B. tabaci* Biotype "Q" during the period of study. Also KZ oil gave toxic effect against the parasitoid, *E. mundus*, *while* Neem Azal and Jojoba oil gave the least effect against the parasitoid.

INTRODUCTION

The biotypes of the whitefly *Bemisia tabaci* (Gennadius) (Homoptera:Aleyrodidae) biotypes are of the most prolific pests of vegetables and ornamental crops around the world (Hamon and Salguero 1987). *B. tabaci* and its biotypes have a host range of over 600 species of plants. Hosts include vegetables (cucumber, beans, eggplant, cabbage, peppers, squash, sugar beet and tomatoes), field crops (cotton, potato, peanut, and soybean) and ornamental plants (poinsettia, hibiscus, etc.) (Simón *et al.,* 2007). High population densities cause death of seedlings, reduction of vigor, photosynthesis inhibition and defoliation. The biotypes are also known as vectors of serious plant pathogenic Gemini viruses such as tomato yellow leaf curl virus (TYLCV), tomato mottle virus (TMOV) and bean golden mosaic virus (BGMV) (Maynard and Cantliffe, 1990). B and Q biotypes of *B. tabaci* are generally regarded by their global distribution and strong resistance to insecticides. Since these biotypes can coexist and differ markedly in their insecticide resistance profiles, a rapid but reliable means of discriminating between them would be a valuable complement to resistance monitoring and management programmes (Jones *et al.,* 2007). The Q-biotype is thought to have originated from the Mediterranean region and has been associated with whitefly control problems. This strain is known to have resistance to pyriproxyfen (Horowitz *et al.* 2003). Two biotypes of the whitefly, *B. tabaci* have been documented from Egypt, biotype B was recognized in the last 1990s (Abd-Rabou, 1999) and biotype Q was first evidenced in 2003 (Abdel-Baky, 2004) . In Egypt, *B. tabaci* was found to colonize on 126 host plant species, while nine associated species of parasitoids were surveyed (Abd-Rabou, 2005). The aim of the present work was to study the population dynamics of *B. tabaci* Biotype Q and its parasitoid *E. mundus* on squash plants in Qalyoubia governorate, as well as assaying the efficacy of come control measures on the pest and parasitoid .

MATERIALS AND METHODS

1. Population dynamics of *Bemisia tabaci* Biotype Q and its parasitoid, *Eretmocerus mundus* :

Population dynamics of *B. tabaci* Biotype Q and its parasitoid, *E. mundus* was carried out on squash plants in Qalyoubia during 2006 and 2007 seasons. The area selected for this investigation was kept free from any chemical control measure for several seasons. Thirty leaves were randomly picked weekly in plant area of (1/4 Fadden). A square inch was inspected/ leaf; 30 inch² were weekly examined. The total number of nymphs/ 30 inches was recorded for each inspection date. The squash was planted in April 5th and the samples were collected from 15th of April to 17th of June.

Chosen squash leaves were detached off and brought to the laboratory for inspecttion. Every leaf was stored in a well-ventilated glass tube and monitored daily for parasitoid emergence. Rate of parasitism was determined by dividing the number of emerging parasitoid individuals from each by the total number of whitefly nymphs to be multiplied by 100.

Records of the meteorological factors mainly the daily mean of minimum (D.Min. T). and maximum (D.Max.T.) temperatures and relative humidity (D.M.R.H.%) were obtained from the daily records of these factors within week prior to sampling date.

Simple correlation values were calculated to obtain information about the relationships between the three tested weather factors and population of the pest.

2 Effect of some natural compounds on *Bemisia tabaci* Biotype Q and its parasitoid, *Eretmocerus mundus* :

This experiment was carried out on squash in Qalyoubia when the population of the whitefly and its parasitoid was high (October, 2007).

The experiments comprised one concentration of four natural compounds i.e. Biofly, Jojoba oil, KZoil, and Neem Azal and an IGR, Buprofezin on eggs, and each of the fourth larval instars, of *B. tabaci* Biotype "Q" infesting squash and the parasitoid, *E. mundus*

Each treatment conducted was in 1/4 fadden divided into 3 replicates (replicate of 442 m² each). Another 1/4 a fadden was also used as an untreated check (control).Spraying was applied at the rate of, Jojoba oil (15 ml/L.), KZoil (15 ml/L)., and Neem Azal (3 ml/L.) .and an IGR, Buprofezin (1 ml/L.) per plant which was accomplished by the use of a Knapsack sprayer Cp-20 of 20 liter capacity . Prespraying counts were made just before spraying. The postspraying counts were made after 1,2 and 3 weeks from application. A square inch was microscopically inspected/ leaf of the collected samples to from a total of 30 square inch/ treatment. A total number of 30 from inches infested leaves for each treatment thus examined. The percentge parasitism was calculated before and after spraying by dividing the number of emerging parasitoids by the number of hosts (excluding non host stages, *i.e.* eggs 1st instar).

RESULTS AND DISCUSSION

1. Population dynamics of *Bemisia tabaci* Biotype Q and its parasitoid, *Eretmocerus mundus*:

Data in Figs (2 & 3) show the populations dynamics of *B. tabaci* and its parasitoid, *E. mundus* on squash plants in Qalubiya Governorate. *B. tabaci* immature stages were almost absent on leaves of the first sample. Data in the same figs. show that, the population of *B. tabaci* increased gradually till reached a maximum of 6475 and 6001 individuals/ 30 inch, with maximum temperature 36°C, minimum temperature 23°C and 67% R.H, in 2006 and 35 and 24°C and 66% R.H (Fig. 1) during the 14th week in 2006 and 2007 seasons, respectively. As for *E. mundus*, results indicated that 125 and 102 individuals of *E. mundus* / 30 inch square of leaves were recorded during the 14th week in 2006 and 2007 seasons under the same aforementioned field conditions.

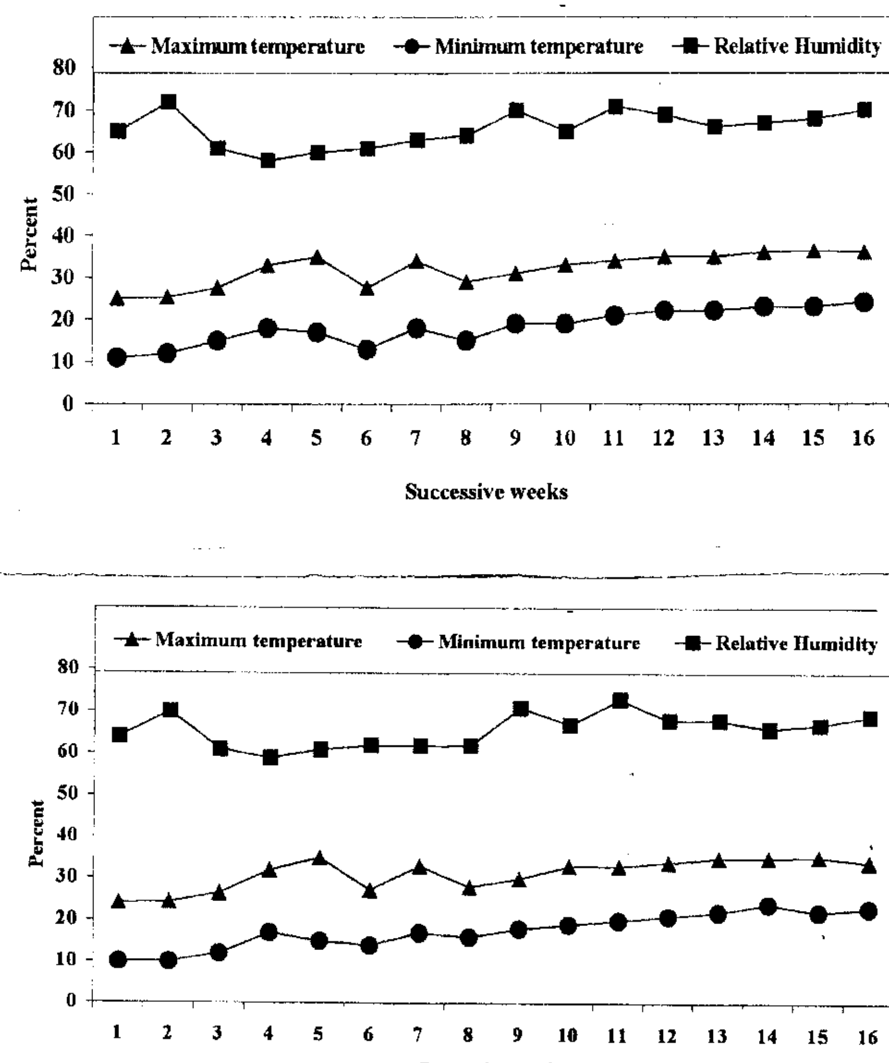

Fig. (1): Weather factors of minimum and maximum temperatures and relative humidity in Qalyoubia Governorate during seasons 2006 and 2007 (starting date, 15th of April).

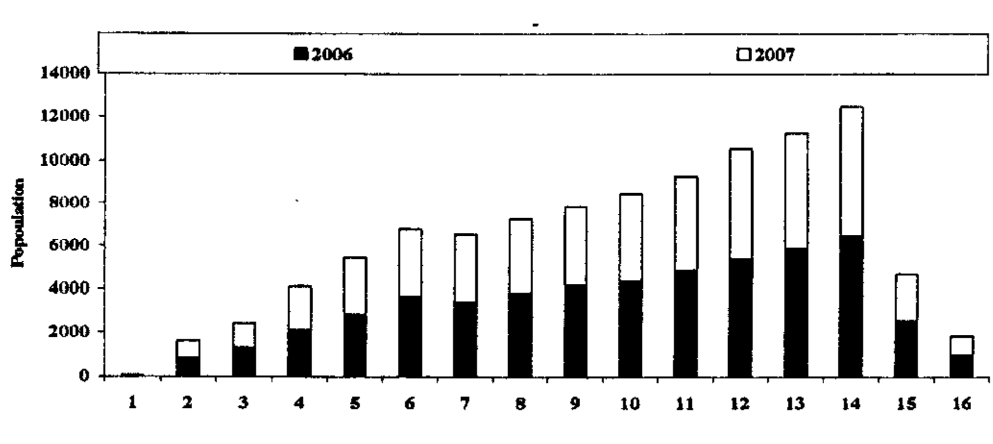

Fig. (2): Population dynamics of Bemisia tabaci Biotype "Q" on squash in Qalyoubia Governorate during the seasons 2006-2007

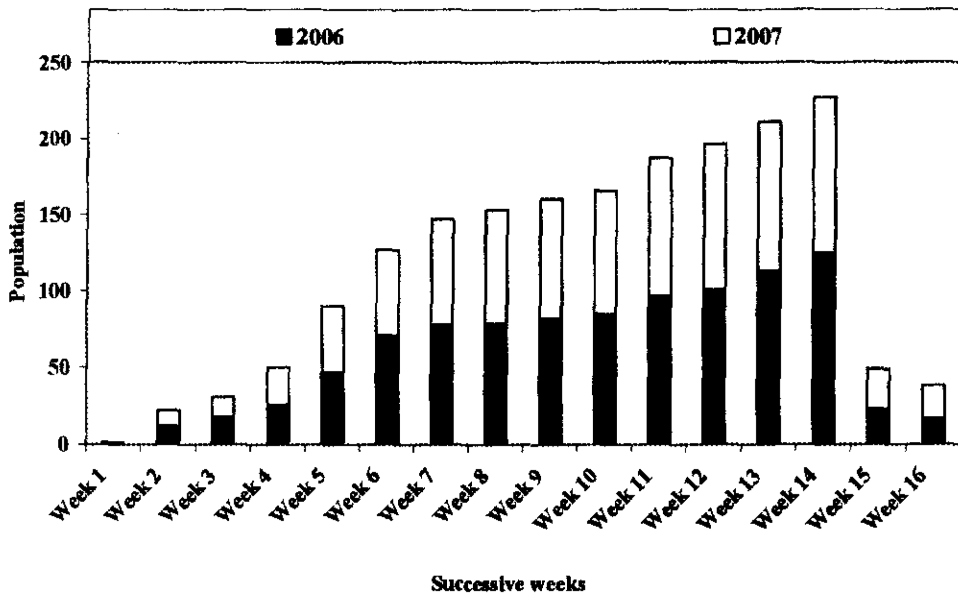

Fig. (3): Population dynamics of the parasitoid, *Eretmocerus mundus* associated with *Bemisia tabaci* Biotype "Q" on squash in Qalyoubia Governorate during the seasons 2006-2007 (Starting date of sampling, 15th of April).

Data in Table (1), show that the simple correlation between the population of parasitoid, *E. mundus* and the mean number of *B. tabaci* Biotype "Q" was positive (r = 0.98) and highly significant, also positive and significant r values (0.54 and 0.55) were recorded between each of maximum or minimum temperatures and the population of whitefly, whereas non-significant r values (0.13) was found between relative humidity% and the population of whitefly. On the other hand, results in Table (1), show that the simple correlation between maximum& minimum temperatures and relative humidity% & the population of *E. mundus* were non-significant (r = 0.45, 0.46 and 0.15), respectively. Results in Table (2), indicated that the simple correlation between the population of parasitoid, *E. mundus* and the mean number of *B. tabaci* Biotype "Q" was positive (r = 0.97) and highly significantly, positive and significant (r = 0.59 and 0.65) between each of maximum or minimum temperature and the population of whitefly, respectively. Meanwhile, it was non-significant value (r = 0.26) was calculated between relative humidity% and the population of whitefly. On the other hand, data in Table (2), showed that the simple correlations between maximum and minimum temperature & the population of parasitoid were significant (r = 0.53, and 0.62, respectively), whereas non-significant r value (0.32) was recorded between relative humidity% and the population of parasitoid.

Different studies on the population dynamics of the immature stages of *B. tabaci* on 15 plants during early summer and winter showed that cucumber was the highest infested food plant in all seasons, followed by marrow in summer and winter and egg plant in early summer .Heavy infestations were generally found on summer crops (El-Sayed *et al.*, 1991). Afsah (1993) studied the seasonal population fluctuations of *B. tabaci* on vegetable crops especially squash. He stated that whitefly peaks occurred during the 4th week of May and the 3rd week of July, respectively. While, in the present work, the peaks of July. The two most widespread biotypes of *B. tabaci* in southern Europe and the Middle East are referred to as the B and Q-type, which are morphologically indistinguishable (Kamel *et al.*, 2000). Analysis of field samples collected for several years using DNA markers indicated that the percentage of the Q biotype tends to increase in field populations (Khasdan *et al.*, 2005). Later, Andress *et al.* (2008) used multivariate analysis techniques to separate the effects of various agroecosystem variables on populations of *B. tabaci* and its native and exotic parasitoids in the Imperial Valley of California. The detected effects were significant and complex. Parasitoid numbers increased with higher *B. tabaci* density, but positive density-dependence was not observed.

Parasitism consistently accounted for a significant portion of *B. tabaci* mortality, and exotics accounted for a large portion of the mortality clearly attributable to parasitoids especially in alfalfa and broccoli. The authors recorded that percentage of parasitism was highest at sites associated with high regional coverage of alfalfa, which seems to be an excellent reservoir for parasitoids. Regional coverage of cantaloupe also seemed to enhance biocontrol of *B. tabaci* at sample sites, including biocontrol from exotics. Populations of parasitoids at sampling sites were enhanced by regional coverage of cotton. While in the present work the relationship between the population of parasitoid and the mean number of *B. tabaci* Biotype "Q" and highly significant on squash crop.

Table (1): Simple correlation and regression values of the population dynamics of *Bemisia tabaci* Biotype "Q" and its parasitoid, *Eretmocerus mundus* on squash in Qalubiya Governorate during 2006

Variable	Insect	Simple correlation "r"	Probability "p"	Regression	Probability "p"
E. mundus	*B. tabaci*	0.98	***	0.96	***
Maximum temp.	*B. tabaci*	0.54	*	0.42	*
Minimum temp.	*B. tabaci*	0.55	*	0.41	*
R.H. %	*B. tabaci*	0.13	Ns	0.14	Ns
Maximum temp.	*E.mundus*	0.45	Ns	0.36	Ns
Minimum temp.	*E. mundus*	0.46	ns	0.32	Ns
R.H. %	*E. mundus s*	0.15	ns	0.17	Ns

Table (2): Simple correlation and regression values of the population dynamics of *Bemisia tabaci* Biotype "Q" and its parasitoid, *Eretmocerus mundus* on squash in Qalyubiya Governorate during 2007 .

Variable	Insect	Simple correlation "r"	Probability "p"	Regression	Probability "p"
E. mundus	*B. tabaci*	0.97	***	0.95	***
Maximum temp.	*B. tabaci*	0.59	*	0.40	*
Minimum temp.	*B. tabaci*	0.65	**	0.48	*
R.H. %	*B. tabaci*	0.26	ns	0.08	Ns
Maximum temp.	*E. mundus*	0.53	*	0.39	*
Minimum temp.	*E. mundus*	0.62	*	0.47	*
R.H. %	*E. mundus*	0.32	ns	0.11	ns

2. Effect of natural compounds on *Bemisia tabaci* Biotype Q and its parasitoid, *Eretmocerus mundus* :

Data obtained during the period of study concerning the efficacy of four natural compounds; Biofly, Jojoba oil, Neemazal, KZoil, and an IGR i.e. Buprofezin on eggs, and the 4 larval instars of whitefly *B. tabaci* Biotype "Q" infesting sugar beet are given in Tables (3 and 4).

Table (3): Pre-spraying and post-spraying numbers of *B. tabaci* "Q" and its parasitoid, *Eretmocerus mundus* on squash in Qalyoubia Governorate.

Treatment	Con.	Pre-treatment					
		Egg	1st	2nd	3rd	4th	P
Buprofezin	1ml/L.	2130	1523	967	742	413	123
Biofly	1.5ml/L.	2251	1620	985	854	523	126
KZ oil	15 ml/L.	2339	1720	1002	901	601	140
NeemAzal	3 ml/L.	2023	1410	854	659	396	124
Jojoba oil	15 ml/L.	2741	1603	990	810	501	131
Control.	-	**2332**	**1420**	**865**	**701**	**368**	**103**
		Post-treatment					
		One week					
Buprofezin	1ml/L.	266	190	120	92	51	15
Biofly	1.5ml/L.	710	631	540	522	325	55
KZ oil	15 ml/L.	210	163	98	77	42	9
NeemAzal	3 ml/L.	845	410	201	515	301	90
Jojoba oil	15 ml/L.	2281	830	247	681	360	98
Control.	-	**2398**	**1521**	**901**	**741**	**370**	**112**
		Two weeks					
Buprofezin	1ml/L.	304	217	138	106	59	17
Biofly	1.5ml/L.	640	598	498	488	287	34
KZ oil	15 ml/L.	197	140	75	62	33	7
NeemAzal	3 ml/L.	731	370	297	470	288	95
Jojoba oil	15 ml/L.	1351	860	330	694	365	100
Control.	-	**2112**	**1410**	**1112**	**820**	**382**	**124**
		Three weeks					
Buprofezin	1ml/L.	236	169	107	82	45	13
Biofly	1.5ml/L.	678	560	440	461	253	35
KZ oil	15 ml/L.	180	121	71	51	29	4
NeemAzal	3 ml/L.	620	351	301	470	281	101
Jojoba oil	15 ml/L.	1620	861	198	691	365	101
Control.	-	**2501**	**1653**	**1354**	**901**	**401**	**135**
		Average					
Buprofezin	1ml/L.	269	192	121.7	93.3	51.7	15
Biofly	1.5ml/L.	676	596.3	492.7	490.3	288.3	41.3
KZ oil	15 ml/L.	196	141.3	81.3	63.3	34.7	6.7
NeemAzal	3 ml/L.	732	377	266.3	485	290	95.3
Jojoba oil	15 ml/L.	1751	850.3	258	688.7	363.3	99.7
Control.	-	**2337**	**1528**	**1122.3**	**820.7**	**384.3**	**123.7**

1st : first larval instar. 2nd : second larval instar.
3rd : third larval instar. 4th : fourth larval instar.
P : parasitoid.

Table (4): Reduction percentages in *B. tabaci* "Q" and, *Eretmocerus mundus* counts in Qalyoubia Governorate after different periods of spraying different compounds.

Treatment	Con.	One week					
		Egg	1st	2nd	3rd	4th	P
Buprofezin	1ml/L.	87.9	88.4	88.1	88.3	87.7	88.5
Biofly	1.5ml/L.	69.3	63.6	47.4	42.2	38.2	59.9
KZ oil	15 ml/L.	91.2	91.2	90.6	91.9	93.0	94.6
NeemAzal	3 ml/L.	40.6	27.1	22.6	26.1	24.4	33.3
Jojoba oil	15 ml/L.	19.1	22.0	19.5	20.5	28.5	31.2
		Two weeks					
Buprofezin	1ml/L.	84.2	85.7	88.9	87.8	86.2	88.8
Biofly	1.5ml/L.	68.6	63.6	60.7	51.1	47.1	71.7
KZ oil	15 ml/L.	90.7	91.8	94.2	94.1	94.4	95.8
NeemAzal	3 ml/L.	39.7	36.4	37.1	39.0	29.2	36.4
Jojoba oil	15 ml/L.	11.8	15.0	32.4	26.8	29.8	36.5
		Three weeks					
Buprofezin	1ml/L.	89.8	91.8	92.9	90.3	90.9	91.9
Biofly	1.5ml/L.	71.9	70.0	71.5	58.0	55.6	97.3
KZ oil	15 ml/L.	92.8	94	95.5	95.6	95.6	89.3
NeemAzal	3 ml/L.	28.6	21.4	22.5	44.5	34.9	37.9
Jojoba oil	15 ml/L.	9.9	13.2	31.2	33.6	33.1	41.1
		Average					
Buprofezin	1ml/L.	87.3	88.6	90.0	88.8	88.0	89.7
Biofly	1.5ml/L.	69.9	65.7	59.9	50.4	47.0	76.3
KZ oil	15 ml/L.	92.0	92.3	93.4	93.9	94.3	93.2
NeemAzal	3 ml/L.	36.3	25.0	24.1	36.5	29.5	35.9
Jojoba oil	15 ml/L.	45.0	16.7	27.7	27.0	30.5	36.3

1st : first larval instar. 2nd : second larval instar.
3rd : third larval instar. 4th : fourth larval instar.
P : parasitoid.

2.1. Effect of different compounds on egg stage:

The average percentages of reductions were and 87.3, 69.9, 92.0, 36.3 and 45.0 for Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil (Table, 4). KZoil was the most effective compound used against eggs of *B. tabaci* Biotype "Q" followed by Buprofezin, Biofly, KZoil, Jojoba oil and Neem Azal, during the period of study.

2.2. Effect of different compounds on first larval instar:

Results in Tables (3 and 4) indicated that the mean percentages of reductions were 88.6, 65.7, 92.3, 25.0 and 16.7 % caused by Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil, respectively. KZoil was the most effective compound used against first larval instar of *B. tabaci* Biotype "Q" followed by Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil during the period of study.

2.3. Effect of different compounds on second larval instar:

As shown in tables (3 and 4) data obtained showed that the mean reduction percentages were 90.0, 59.9, 93.4, 24.1and 27.2 caused by Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil, respectively (Table, 4). KZoil was the most effective compound against second larval instar of *B. tabaci* Biotype "Q" followed by Buprofezin, Biofly, Jojoba oil and Neem Azal during the period of study.

2.4. Effect of different compounds on third larval instar:

The average percentages of reductions were 88.8, 50.4, 93.9, 36.5 and 27.1%

for Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil (Table, 4). KZ oil was the most effective compound used against third larval instar of *B. tabaci* Biotype "Q" followed by Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil during the period of study.

2.5. Effect of different compounds on fourth larval instar:

The average percentages of reductions were 88.0, 47.0, 94.3, 29.5 and 30.5 % for Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil (Table, 4). KZoil was the most effective compound used against fourth larval instar of *B. tabaci* Biotype "Q" followed by Buprofezin, Biofly, KZoil, Jojoba oil and Neem Azal during the period of study.

In accordance with the present results, Ishaaya *et al.*, (1988) indicated that Buprofezin caused larval mortality of *Bemisia.* Wilson and Anema (1988) used Buprofezin for the control of *B .tabaci* in the Netherlands and UK .They found that spraying of Buprofezin at 7 .5 g. I / litre applied at high volume provided long – term control of these pests on green house crops for 10 weeks. The average reduction percentage in *B. tabaci* counts by Buprofezin ranged between 87.3 and 90.0%. Butler and Henneberry, (1991) studied the effect of oil sprays on sweet potato whitefly, *B. tabaci* on water melons, squash and cucumber. One or two applications of 1-2 % oil in water repelled or killed adults and immatures of *B. tabaci* for up to 7 days following application and caused no significant phytotoxicity when the used concentration reached 5% oil in water. During the present work KZoil was the most effective compound tested against the different stages of *B. tabaci* Biotype "Q" (percent reduction ranged between 92.0 and 94.3%).

The reduction percentages after Biofly treatment on different stages of *B. tabaci* Biotype "Q" in the present study ranged between 47.0-69.6%. Schaaf *et al.* (1990) tested the fungi, *Verticillum lecanii* as a wettable powder (My Cotal) for the control *B. tabaci* on cucumber and tomatoes. Weekly sprays with My Cotal at 103 spores / ml resulted in a 90 % reduction of population of this pest. Zaki *et al.* (2002) stated that *Beauveria bassiana* as effective in controlling *B. tabaci* infesting cucumber. A dose of 1 mg/ ml /L. caused 100% mortality. Mortality decreased with decreasing concentrations and nymphs were most susceptible to fungus.

2.6. Effect of different compounds on the parasitoid, *Eretmocerus mundus*:

Data in Tables (3 and 4) showed the effect of four different natural compounds and IGR against the parasitoid, *E. mundus* associated with *B. tabaci* Biotype "Q" on squash. The average reduction percentages of the parasitoid were 89.7, 76.3, 93.2, 35.9 and 36.3 % after Buprofezin, Biofly, KZoil, Neem Azal and Jojoba oil treatments, respectively.

As shown in table (4) KZoil gave toxic effect against the parasitoid, *E. mundus.* The obtained results indicated that KZoil, Buprofezin and Biofly gave over than 75% reduction against the parasitoid. On the other hand, Neem Azal and Jojoba oil gave more than 35% average reduction against the parasitoid. This may be due to that Neem Azal and Jojoba oil are natural oils (plant extractions). Buprofezin was reported as of very low toxicity to the parasitoid in different parts of the world (Martin and Workman, 1986). Kornilov and Ivanova (1991) studied the effect of Buprofezin on the parasitoid *Encarsia* sp. of *B. tabaci* on cucumber. They stated that the parasitism reached 87-96% after application. Abd-Rabou (2001) tested the natural compound (NeemAzal) on the *B. tabaci* parasitoid, *E. mundus*, the results indicated that the percent reduction ranged between 37.1 to 24.5% after one week of spraying. These results agree with the findings of the present work where the average percent reduction was35.9%.

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ذبابة القطن والطماطم البيضاء السلالة (Q) والطفيل المتخصص عليها اريتموسيرس مندس على نباتات الكوسة وبعض التطبيقات لمكافحتها

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سجلت السلاله (Q) لذبابة القطن والطماطم البيضاء حديثا خلال الثلاث سنوات الأخيرة . تضمن هذا العمل دراسات موسمية على تعدادات ذبابة القطن والطماطم البيضاء السلالة Q والطفيل المتخصص عليها اريتموسيرس مندس على نباتات الكوسه خلال موسمى الدراسه ٢٠٠٦ و ٢٠٠٧ ثم دراسة تأثير بعض المركبات الطبيعية وأحد منظمات النمو فى الحشرات لمكافحة هذه السلالة وأشارت النتائج الى أن أعلى قمة في التعداد الحشرى للذبابة البيضاء سلالة Q كانت ٦٤٧٥ و ٦٠٠١فرد لكل ٣٠ بوصة مربعة فى الأسبوع الرابع عشر (شهر...) اثناء سنتى الدراسة ٢٠٠٦ و ٢٠٠٧ . كما سجلت ايضا أعلى قمة فى التعداد الحشرى للطفيل كانت ١٢٥و ١٠٢فرد لكل ٣٠بوصة مربعة فى نفس الأسبوع أيضاً اثناء سنتى الدراسة ٢٠٠٦ و ٢٠٠٧ على الترتيب. أما بالنسبة لنتائج المركبات الطبيعية فقد أتضح من النتائج ان الزيوت المعدنية كانت أكثر المركبات تاثيرا على الذبابة البيضاء وأيضا كان لها تاثيرا سلبيا على الطفيل بينما كان النيمازال و زيت الجوجوبا لهما تاثيرا أقل على الطفيل.