

POPULATION FLUCTUATION OF THRIPS, WHITEFLY AND ASSOCIATED PREDATORS IN CABBAGE PLANTATIONS AS INFLUENCED BY WEATHER FACTORS AND TOXIC COMPOUNDS

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ABSTRACT

Field experiments were conducted during two successive cabbage growing seasons (2008/09 and 2009/10) at El-Riad district, Kafr El-Sheikh Governorate. The objective was to study the population fluctuation of thrips, *Thrips tabaci* Lind., whitefly, *Bemisia tabaci* (Genn.) and their predators (*Chrysoperla carnea* and true spiders) in cabbage plantations. The toxicity of Marshal and Bermectine in reducing the population density of *T. tabaci* and *B. tabaci* infesting cabbage was evaluated. Also, the side effect of these compounds on *Chrysoperla carnea* and true spiders was assessed. Beside the effect of weather factors (mean temperature, relative humidity and wind velocity). Population fluctuations of *T. tabaci* reached maximal abundance in March and early April in both seasons. *B. tabaci* was the earliest insect, among sucking pests, to attack cabbage plants, the population fluctuations reached maximal abundance in September and October in the both seasons. Highest abundance of *C. carnea* occurred in early November and April in the first season while it occurred in January and February in the second season. In both seasons, the maximum number of true spiders was detected in October and April. Temperature had a highly significant negative effect on thrips infestations, while wind velocity had a highly significant positive correlation with thrips in the first season. Whitefly tended to increase with an increase in the median temperature. True spiders correlated highly significant and negatively with whitefly in the first season. The joint effect of weathering factors and predators on the populations of thrips and whitefly was higher in first season than in second season. Marshal and Bermectine under field conditions caused reduction in infestation of *T. tabaci*. The effects of both compounds on whitefly (mature and immature stages) were high to moderate. Concerning the side effects on the predators, Marshal induced moderate effect while Bermectine exhibited a slight effect against *C. carnea* and true spiders.

INTRODUCTION

Cabbage, *Brassica oleracea* var. *capitata* Linneu, cultivated worldwide, is attacked by pests such as thrips, *Thrips tabaci* Lindeman (Thysanoptera:Thripidae) and whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera : Aleyrodidae). (Farrag and Zakzouk, 2000, Leite *et al.*,2005 and 2006 and Mahmoud *et al.*,2009). These insects weaken the plant by sucking the sap and introducing toxins into the plants vascular system, coating the leaf with honeydew, facilitating the growth of soot mold, and producing white streaking disorder, leaf chlorosis and leaf wrinkling. Thrips and whitefly cause direct damages to crops through feeding on plants sap and transmission of harmful plant viruses. Insects attacking cabbage are controlled by blanket spraying with foliar insecticides. The frequency of insecticide applications is determined by the degree of damage, which is heavily influenced by cosmetic considerations (Leite *et al.*,2006).

Several factors such as climatic conditions, predators and certain chemical compounds can influence insect population on plants (Horowitz, 1986, Hook *et al.*, 1998, Abo– Sholoa, 2001, El-Naggar *et al.*, 2006 and Leite *et al.*,2005 and 2006). However, these factors have been little studied in cabbage.

The objectives of this study are to correlate abundance of predators (*C. carnea* and true spiders) and weather factors with abundance of *T. tabaci* and *B. tabaci* attacking cabbage under field conditions. Also, efficiencies of Marshal and Bermectine in reducing the population density of *T. tabaci* and *B. tabaci* infesting cabbage plants and their side effects on *C. carnea* and true spiders.

MATERIALS AND METHODS

1-Population fluctuation of sucking pests and their predators in cabbage plantations :

Population fluctuations of *Thrips tabaci* , *Bemisia tabaci*, *Chrysoperla carnea* and true spiders on cabbage (*Brassica oleracea* var. *capitata* Linneu) were investigated. Field experiments were carried out at El- Riad district, Kafr El- Sheikh Governorate during two growing seasons ; 2008/09 and 2009/10. Cabbage seedlings were sown on August 15th, November 20th and February 26th on both seasons. An area of about one half feddan was divided into four equal plots, and considered as four replicates. Inspection started 30 days after sowing, and continued weekly till the end of the crop season. Numbers of thrips (nymphs and adults) and whitefly (adults) were counted in the field on ten leaves/replicate in the morning (7-9 am).The same samples were taken the laboratory to count the number of immature stage of whitefly using binocular microscope. *C. carnea* (eggs, larvae and adults) and true spiders (mobile stages) were also counted on ten plants/ replicate in the field. The obtained numbers were transformed as square roots.

2- Climatic factors :

The daily mean temperature, daily relative humidity and wind velocity were supplied by the Meteorological Department at Sakha Agricultural Research Station.

3- Toxicity of the tested compounds against thrips, whitefly, *Chrysoperla carnea* and true spiders :

Toxicological studies were carried out at a field of cabbage (one half feddan) at El- Riad district, Kafr El- Sheikh Governorate during 2008/09 and 2009/10 seasons. The tested compounds were applied at recommended doses using a knapsack sprayer with one nozzle. These compounds were sprayed on March 26th (2008/09) and April 2rd (2009/10) of thrips and October 9th (2008/09) and September 25th (2009/10) for whitefly. Every treatment was replicated four times, in addition to an untreated area to act as check. The experiment was designed in a complete randomized block design. The tested compounds and rate per 100 liters water were as follows:

- A. Pesticide : Carbosulfan (Marshal) 25 % WP at 150 g /100L water.
B. Biopesticide : Abamectin (Bermectine) 1.8% EC at 40 ml /100L water.

Pre – treatment counts of *T. tabaci* (nymphs and adults), whitefly (immature and adults), *Chrysoperla carnea* (larvae) and true spiders (mobile stages) were recorded before spraying at 40 cabbage leaves for thrips and whitefly, but for 40 cabbage plants for predators for each treatment. Post–treatment counts were recorded 1, 3, 5, 7, 10 and 14 days after applications. These leaves were kept in a paper bag and were immediately examined by using a binocular microscope in the laboratory to count the number of nymphs and pupae of the whitefly. Percentage of reduction was calculated according to Henderson and Telton (1955) equation.

RESULTS AND DISCUSSION

1-Population fluctuation of sucking pests and their predators :

Data illustrated in Figure (1) show the populations density of *Thrips tabaci* started to appear by the second week of December (2008/09) and the first week of October (2009/10). In 2008 /09, the peaks were recorded on December 18th, February 19th and March 26th, while they were recorded on October 16th, December 18th and April 9th in the second season (in agreement with Leite *et al.*,2005 and 2006). It reached its maximal abundance on March and April in both seasons (Fig.1). Similar results were reported by Kimberly and Anthony (1988), Ibrahim and Adesiyun (2009).

Population density of whitefly are presented in Fig. (2&3). This insect pest was the earliest to appear among sucking pests, to attack cabbage plants in 2008 /09 and 2009/10 seasons. Two whitefly peaks were recorded in each season. In the first season, the dense population of whitefly (adults) was recorded on October 16th and November 6th , while they were recorded on September 25th and March 5th in the second season. Population density of whitefly (immature) was recorded on October (16th and 30th) in 2008/09 season and November 20th and April 23th in 2009/10 season. Similar results were reported by Seham *et al.*(1997), Farrag and Zakzouk (2000), Nassef *et al.* (2000) and El- Fakharany (2005). Leite *et al.* (2006) found that whitefly population tended to proliferate in the final stage of plant or reached a peak of population about 40 days after plantation.

Population densities of the considered predators are presented in Fig.(4& 5). The true spiders were more abundant than *Chrysoperla carnea*, and exhibited four peaks during the two seasons of study, on October 23th , November 6th, January 29th and April 9th in the first season and on December 18th, January 15th, March 5th and April 16th in the second one. In the first season, the dense population of true spiders was recorded on October (16th and 30th), January 8th and April 30th. These peaks occurred on September 25th, December 4nd, January 15th, March 5th and April 30th in 2009 /10 season.

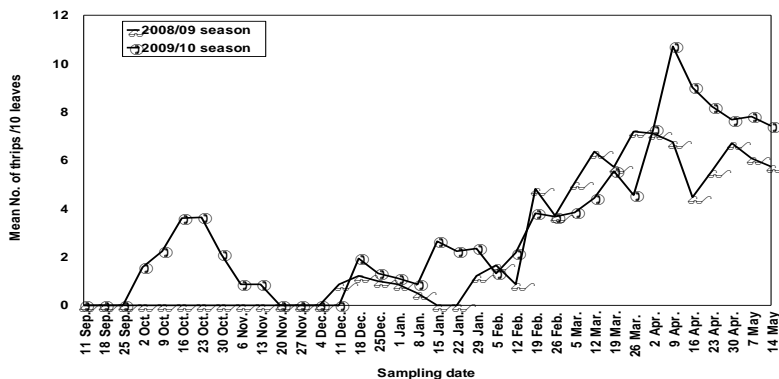


Fig. (1) : Population fluctuation of *Thrips tabaci* (nymphs and adults) on cabbage plants at El-Riad district, Kafra El-Sheikh Governorate .

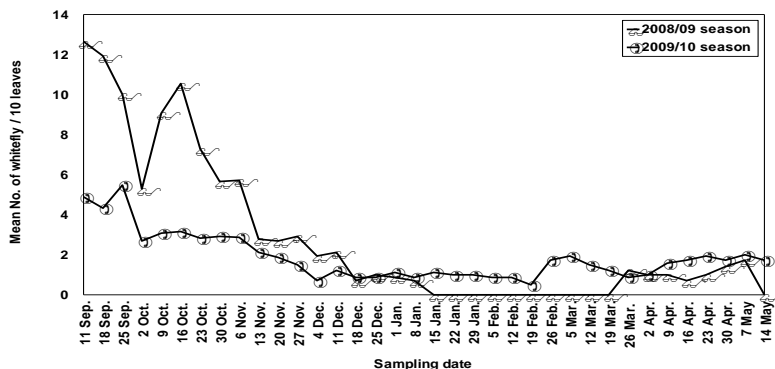


Fig. (2) : Population fluctuation of *Bemisia tabaci* (adults) on cabbage plants at El-Riad district, Kafra El-Sheikh Governorate .

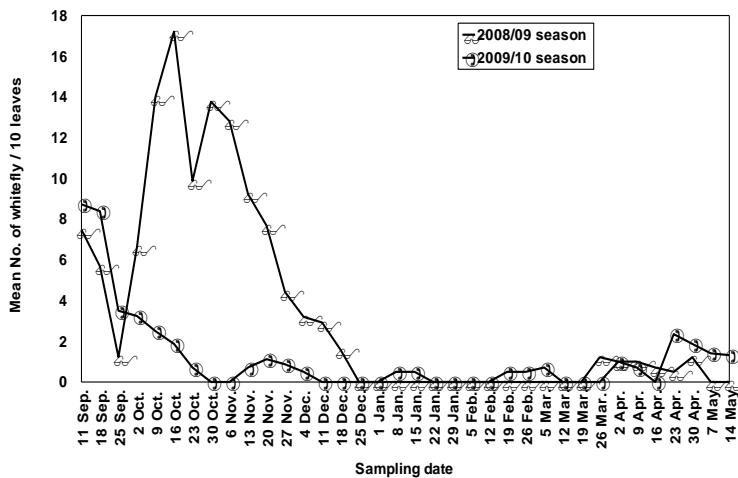


Fig. (3) : Population fluctuation of *Bemisia tabaci* (immature) on cabbage plants at El-Riad district, Kafra El-Sheikh Governorate .

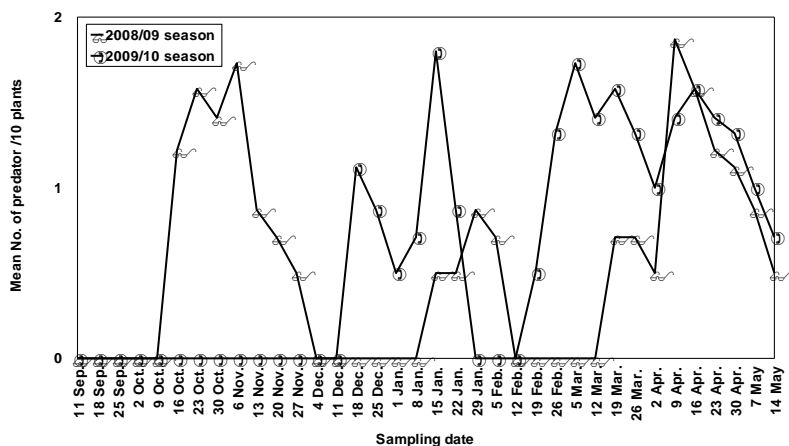


Fig. (4) : Population fluctuation of *Chrysoperla carnea* (immature and adults) on cabbage plants at El-Riad district, Kafra El-Sheikh Governorate .

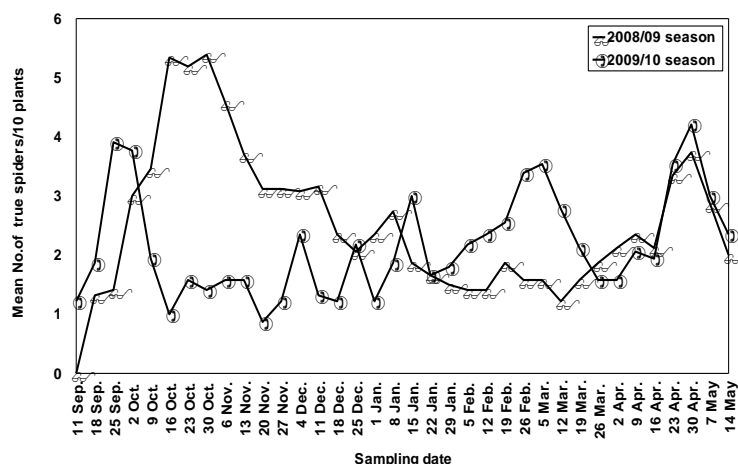


Fig. (5) : Population fluctuation of true spiders (spiderlings and adults) on cabbage plants at El-Riad district, Kafra El-Sheikh Governorate .

**2- Effect of climatic factors and predators on thrips and whitefly :
Thrips tabaci :**

Data in Table (1) showed that the temperature induced highly significant negative effect in 2008/09, insignificant positive in 2009/10 (in agreement with El-Fakharany,2005). Relative humidity had an insignificant negative effect in 2008/09 and an insignificant positive effect in 2009/10 season. Wind velocity had a highly significant positive effect in 2008/09 season and an insignificant positive effect in the second season. Hamdy and Salem (1994) found that correlation between onion thrips and temperature was significant and positive while it was significant and negative with relative humidity.

Bemisia tabaci

The temperature had a highly significant positive effect on *B. tabaci* population in both seasons. Seham *et al.* (1997), Nassef *et al.* (2000), Abo-Sholoha (2001), El-Fakharany (2005) and Leite *et al.* (2006) found that whitefly population tended to increase with increase of temperature. Relative humidity had an insignificant positive effect in both seasons (Nassef *et al.*, 2000 and El-Fakharany, 2005). Wind velocity had an insignificant negative effect in 2008/09 season and an insignificant positive effect in 2009/10 season.

C. carnea population insignificantly negative correlated with *B. tabaci* population in both seasons. While true spiders had a highly significant negative effect in 2008/09 season and insignificant negative effect in the second season (Table,1).

Table (1): Partial correlation (r) and regression coefficient (B) between climatic factors, predators and the population of *Thrips tabaci* and *Bemisia tabaci* on cabbage at El-Riad district, Kafr El-Sheikh Governorate .

Season	Variables	<i>Thrips tabaci</i>			<i>Bemisia tabaci</i>		
		r	B	E.V%	r	B	E.V%
2008/09	Mean temperature (c°)	-0.5190**	-2.329**	61.60	0.6760**	17.197**	69.60
	Mean R.H(%)	-0.1624	-0.570		0.2499	4.369	
	Wind velocity (m/h)	0.6803**	0.559**		-0.1629	-0.486	
	<i>Chrysoperla carnea</i>	0.2861	4.583		-0.2705	-21.076	
	True spiders	-0.3762	-0.760		-0.6887**	-8.684**	
2009/10	Mean temperature (c°)	0.2317	1.552	39.00	0.5634*	3.469*	40.40
	Mean R.H (%)	0.1888	1.095		0.0906	0.404	
	Wind velocity (m/h)	0.2868	0.366		0.0786	0.0753	
	<i>Chrysoperla carnea</i>	0.3258	10.645		-0.1145	-2.779	
	True spiders	0.0076	0.0407		-0.1177	-0.497	

3- The combined effect of temperature, relative humidity, wind velocity and predators on thrips and whitefly :

In general, the combined effect (percentage of explained variance) in Table (1) of the four factors on thrips and whitefly was higher in the first year (61.60 and 69.60%, respectively) than in the second one (39.00 and 40.40%, respectively). Nassef *et al.* (2000) and Ibrahim (2002) indicated into the important role of climatic factors and predators, that influenced population densities of pests.

4. Follow – up the potency of compounds :

The effect of the tested compounds on *T. tabaci* and *B. tabaci* infesting cabbage plants at El- Riad district, Kafr El- Sheikh Governorate is presented in Tables (2,3).

***Thrips tabaci* :**

Data revealed that Bermectine was the most potent compound in reducing the population density of thrips during 2008/09 and 2009/10 seasons, with reductions (grand average) of 95.84 and 96.75 %, respectively. It was followed by Marshal with reductions of 95.64 and 96.47 %, respectively.

Generally, biopesticide (Bermectine) exhibited high effectiveness. These results agree with the findings of Omar and El-Kholy (2001), El- Fakharany (2005), Thungrabeab *et al.* (2006), Mahmoud and Osman (2007) and Mahmoud *et al.* (2009).

***Bemisia tabaci* :**

Concerning whitefly ,data obtained in Table (3) show that Marshal induced the highest initial effect, exhibiting 83.50 and 81.40 % reduction on mature stage and 84.00 and 84.50 % reduction on immature stager during 2008/09 and 2009/10 seasons, respectively. However, it gave a moderate residual effect during the two seasons, it exhibited 64.64 and 62.76% reduction against mature stage, respectively. El- Naggat *et al.* (2006) found that the effect of Marshal on whitefly (adults and immature stages) was moderate. Ismail *et al.* (1998) reported that Marshal was effective against mature and immature stages of whitefly in the field. On the other hand, Bermectine gave moderate initial effect exhibiting 70.01 and 69.80 % reductions against adults and 75.00 and 74.00 % reductions against immature stage respectively , during the two seasons. It induced residual effects of 68.28 and 65.48 % for adults and 74.90 and 71.79 % in the immature stage in the two seasons respectively. Similar results were reported by El- Bessomy *et al.* (1997) and Horowitz *et al.* (1997).

5. Side toxic effects of Marshal and Bermectine *Chrysoperla carnea* and true spiders inhabiting cabbage plantations :

The results recorded in Table (4) revealed that Marshal induced a moderate effect against predators, while Bermectine gave a slight effect in the two seasons. The present results are in agreement with the finding of Sharaf *et al.* (2003), El- Fakharany (2005) and El- Naggat *et al.* (2006). The results showed that biopesticide was safer to associated predators than pesticide.

Conclusions

- 1-The highest abundance of thrips on cabbage was detected in March and early April, while that of whitefly was detected earlier .*B. tabaci* was the earliest insect to appear among sucking pests on cabbage plants.
- 2- *B. tabaci* can be a harmful pest in cabbage cultivated in regions of high temperature. A joint effect of weathering factors and predators was found more remarkably on the density of thrips and whitefly in 2008/09 than 2009/10 seasons . Predators , especially the true spiders seemed to be important controlling agents of the *B. tabaci* population in cabbage.
- 3- Marshal and Bermectine caused more reduction in infestation with thrips than with whitefly in cabbage. Marshal induced moderate effect against predators while Bermectine exhibited a slight effect.

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**التذبذب العددي لحشرة تريبس البصل والذبابة البيضاء و مفترساتها في زراعات
الكرنب وتأثير العوامل الجوية و المركبات الكيماوية
ثناء قطب مرسى الفخرانى
معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - الجيزة - مصر**

يهدف البحث إلى دراسة الكثافة العددية لتريبس البصل والذبابة البيضاء و مفترساتهما في زراعات الكرنب تحت بعض الظروف الجوية. وكذلك دراسة التأثير السام لمبيدات ماريشال و برمكتين على تعداد تريبس البصل و الذبابة البيضاء (الأطوار الكاملة و الغير الكاملة) في الكرنب و أيضا دراسة الأثر الجانبى للمركبات المختبرة على المفترسات (يرقات أسد المن و العناكب الحقيقية) حيث تم إجراء هذا البحث بمركز الرياض محافظة كفر الشيخ عامى 2008 / 09 ، 2009 / 10 . أظهرت النتائج أن أعلى كثافة عددية للتريبس سجلت في مارس و أول ابريل خلال موسمى الدراسة أما الذبابة البيضاء (الأطوار الكاملة و الغير الكاملة) فكانت أكثر ظهورا في أول الموسم خلال سبتمبر و أكتوبر في كلا الموسمين . و سجل أسد المن أعلى تعداد له في أول نوفمبر و ابريل في الموسم الأول بينما سجل أعلى تعداد له في يناير و فبراير في الموسم الثانى . و أيضا سجلت العناكب الحقيقية أعلى تعداد لها في أكتوبر و ابريل في كلا الموسمين. كما دلت النتائج أن هناك تأثيراً واضحاً للظروف الجوية و المفترسات على تعداد التريبس و الذبابة البيضاء حيث كانت لدرجات الحرارة معنوية سالبة و لسرعة الرياح معنوية موجبة مع التريبس في الموسم الأول . أيضا وجد أن درجات الحرارة تساعد على زيادة تعداد الذبابة البيضاء مع وجد ارتباط معنوى موجب .بينما كانت للعناكب الحقيقية علاقة معنوية سالبة مع الذبابة البيضاء في الموسم الأول . كما كان التأثير المشترك للعوامل الجوية و المفترسات على التريبس و الذبابة البيضاء واضحا .أوضحت النتائج أن الماريشال و برمكتين أدى إلى خفض تعداد التريبس على نباتات الكرنب بينما كان تأثيرهما على الذبابة البيضاء (الغير الكاملة و الأطوار الكاملة) متوسطا أو عاليا مع اختلاف نسب الخفض في الإصابة . عند دراسة الأثر الجانبى للمركبات المختبرة على المفترسات المصاحبة للتريبس و الذبابة البيضاء ظهر أن الماريشال متوسط السمية و بينما كان تأثير برمكتين طفيف جدا على (أسد المن و العناكب الحقيقية) .

قام بتحكيم البحث

**أ.د / حسن محمد فتحى
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Table (2): Potency of Marshal and Bermectine in reducing *Thrips tabaci* populations on cabbage plants at EI- Riad district, Kafr EI- Sheikh Governorate.

Compound	Rate/ 100 liter of water	season	Number pre- treatment /10 leaves	% Reduction							
				Initial effect %	Residual effect after indicated days					Residual effect average	Grand average
					3	5	7	10	14		
Pesticide Marshal	150 g	2008/09	106.50	99.57	98.51	97.66	95.63	93.84	88.60	94.85	95.64
Biopesticide Bermectine	40 ml		98.50	99.41	97.95	97.18	96.17	94.29	90.01	95.12	95.84
Untreated*	-		102.50	105.00	133.75	142.75	145.50	156.25	155.75	-	-
Pesticide Marshal	150 g	2009/10	225.00	99.82	99.82	98.38	97.35	93.67	89.78	95.80	96.47
Biopesticide Bermectine	40 ml		214.25	99.81	99.81	98.07	97.06	94.21	91.53	96.14	96.75
Untreated*	-		207.75	210.50	216.00	221.25	221.75	235.00	202.50	-	-

* Numbers

Table (3): Potency of Marshal and Bermectine in reducing *Bemisia tabaci* populations on cabbage plants at El-Riad district, Kafr El-Sheikh Governorate.

Compound	Rate/ 100 liter of water	season	Number pre- treatment /10 leaves	% Reduction							
				Initial effect %	Residual effect after indicated days					Residual effect average	Grand average
					3	5	7	10	14		
Adult											
Pesticide											
Marshal	150 g	2008/09	160.00	83.50	77.01	69.00	64.50	60.20	52.50	64.64	67.79
Biopesticide											
Bermectine	40 ml		142.25	70.01	75.00	77.00	67.00	62.20	60.20	68.28	68.57
Untreated*	-		100.25	120.00	137.00	140.25	150.00	169.50	180.00	-	-
Pesticide											
Marshal	150 g	2009/10	196.25	81.40	74.20	70.00	61.90	58.50	49.20	62.76	65.87
Biopesticide											
Bermectine	40 ml		189.75	69.80	72.00	75.00	65.50	59.40	55.50	65.48	66.20
Untreated*	-		164.00	169.50	172.00	177.00	180.00	181.00	190.00	-	-
Immature (nymphs and pupae)											
Pesticide											
Marshal	150 g	2008/09	111.00	84.00	81.50	73.00	71.90	65.20	61.40	70.60	72.83
Biopesticide											
Bermectine	40 ml		97.00	75.00	81.20	82.00	79.00	69.80	62.50	74.90	74.92
Untreated*	-		76.25	80.00	85.00	93.00	99.00	108.00	117.00	-	-
Pesticide											
Marshal	150 g	2009/10	84.00	84.50	80.60	70.90	68.50	62.20	59.80	68.40	71.08
Biopesticide											
Bermectine	40 ml		101.00	74.00	79.80	80.50	73.20	65.40	60.08	71.79	72.16
Untreated*	-		79.00	99.00	104.00	111.00	115.00	120.00	121.00	-	-

* Numbers

Table (4): Potency of tested compounds in reducing predators populations on cabbage plants at EI- Riad district, Kafr EI- Sheikh Governorate.

Compound	Rate/ 100 liter of water	season	Number pre- treatment /10 plants	% Reduction							
				Initial effect %	Residual effect after indicated days					Residual effect average	Grand average
					3	5	7	10	14		
Pesticide											
Marshal	150 g	2008/09	15.00	50.00	45.50	37.02	29.29	16.50	6.92	27.05	30.87
Biopesticide											
Bermectine	40 ml		13.50	13.00	2.75	00.00	00.00	00.00	00.00	0.55	2.63
Untreated*	-		14.00	16.00	18.75	19.50	20.25	22.75	25.50	-	-
Pesticide											
Marshal	150 g	2009/10	14.50	55.00	49.00	39.00	32.00	17.00	5.01	28.40	32.84
Biopesticide											
Bermectine	40 ml		12.75	14.25	4.00	0.50	00.00	00.00	00.00	.90	3.13
Untreated*	-		13.00	13.75	15.00	17.25	19.00	19.25	24.00	-	-

* Numbers

predators : *Chrysoperla carnea* and true spiders