INTEGRATED MITE MANAGEMENT I- EVALUATION OF SOME COMPOUNDS AGAINST THE TWO SPOTTED SPIDER MITE, *TETRANYCHUS URTICAE* AND TWO PREDATORS *AMBLYSEIUS FALLACIS AND PHYTOSEIULUS PERSIMILIS*

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ABSTRACT

The present study was carried out to evaluate the toxic effect of six compounds of different mode of actions, three acaricides (abamectin, ethion and chlorfenapyr), one pyrethroid (cyhalothrin), one mineral oil (Nat1), and one plant extract (black cumin) against the eggs and adult females of the two spotted spider mite, *Tetranychus urticae* (Koch) and adult females of two predatory mites, *Amblyseius fallacies* (Garman) and *Phytoseiulus persimilis* (Athias-Henriot) using leaf-disc dip technique. The results indicated that, abamectin has a special position in mite chemical control or in integrated mite management because of its high toxic effect and it's high toxicity index among different mite control agents. Black cumin extract was the poorest toxic compound to adult females of *T. urticae*. Cyhalothrin and abamectin have a special effect on eggs of *T. urticae* and considered the best compounds that have a special importance in integrated mite management. The mineral oil Nat1 was more toxic to egg stage of *T. urticae* than black cumin extract. Nat1 and black cumin extract are the safest compounds to adult females of both predatory mites *A. fallacis* and *P. persimilis*. Cyhalothrin has the highest selectivity index and highest selectivity ratio, in spite of it's low safety index value. Thus it could be recommended in IPM programs. Nat1, chlorfenapyr and ethion were the next compounds after cyhalothrin in their selectivity ratio values, but Nat1 has a special position and considered promising oil in mite control programs. Abamectin has the least values of selectivity index and selectivity ratio and it's low safety index make us to keep it in mined under certain conditions (in case of rare predators with high level of phytophagous mites).

INTRODUCTION

Tetranychid mites are common pests in agro-system, causing, in many cases, economic greater losses than any other arthropod pests. The two spotted spider mite, *Tetranychus urticae* is considered as one of the major pests attacking different agricultural crops such as field crops,

vegetables, fruits and ornamental plants. The infestation by mites caused great damage to infested plants compared with those infested with infestation pathogens. The two-spotted spider mite *T. urticae* (Koch) has been extensively studied and the early work was reviewed by Huffaker *et al.* (1969). *T. urticae* infests a wide range of economic plants in the field such as cotton (Leigh *et al* ., 1968), strawberry (Sances *et al.*, 1982), cucumber (De-ponti, 1980), tomato (Rodriguez *et al.*, 1972) , peanuts (Boykin and Campbell, 1982) , peppermint (Hollingsworth, 1980). Tobacco, cucumber, beans and tomato are also attacked under glass houses (Patterson *et al.*, 1974), together with numerous ornamental plants (Hamlen and Lindquist, 1981). Fruit orchards may also be infested and damage has been reported on apple, peach, pear, almond and walnut (Hoy *et al.*, 1980; Penman and Chapman, 1980). Jahangir *et al.*, (2009) evaluated the possible antagonism of organophosphate and carbamate insecticides on bifenazate toxicity in *Tetranychus urticae* applied in mixtures. Several organophosphate (chlorpyrifos, azinphosmethyl and phosmet) and carbamate (carbaryl and methomyl) insecticides were used. They indicate that mixing organophosphate and carbamate insecticides with bifenazate may inhibit bifenazate efficacy under field conditions, especially when resistant strains are present

For that, all world are going to reduce chemicals use trying to introduce predators and the entomopathogens (such as virus, bacteria and fungi) in integrated pest management (IPM) programs. These natural enemies are frequently responsible for maintaining spider mite populations below damaging levels.

The use of predators had proved the most effective control method for Tetranychid mites and the most effective predators have been found in the family Phytoseiidae (Huffaker *et al.* 1970; Abou Awad and EL-Banhawy, 1985).

The possibility of controlling phytophagous mites by a combination of biological and chemical methods had proved a less costly and more permanent method of control than had pesticides alone (Hosny et al., 2003 and Magouz and Saadoon, 2005)

The present study was carried out to examine the toxic effect of six tested compounds against the eggs and the adult females of the two spotted spider mite *T. urticae* (Koch) and two predators were used in this study namely *Amblyseius fallacis* and *Phytoseiulus persimilis*.

MATERIALS AND METHODS

Prey Cultures:

The two-spotted spider mite, *Tetranychus urticae* (Koch) (Acarina: Tetranychidae), colonies were obtained from castor bean plants from Kafr El-Sheikh Governorate and reared under laboratory conditions according to Dittrich (1962). The prey culture was kept at 25 ± 2°C under 16 hour's photoperiod to encourage plant growth, and 70 ± 5 R.H.

Predator culture:

Two predators used in this study are *A. fallacis* and *P. persimilis*. *A. fallacies* (Garman) (Acarina: Photoseiidae), was collected and described by Garman (1948). It is of particular interest to biologists concerned with the development of IPM systems. The predator was reared on pollen grains of castor bean (*Ricimus communis*) plants as described by Overmeer *et al.* (1982).

Chemicals used:

Six compounds were used. The chemical names for the tested compounds are as follows:

1- **Abamectin** (1.80% EC) a mixture containing a minimum of 80% avermectin B_1a (5-0 demethyl avermecin A_1a) and a maximum of 20% avermectin B_1 b [5-0-demethyl – 25 –de (1 methyl – propyl)– 25- (1-methyl ethy) avermectin A_1 a].
2- **Ethion** (50% EC) 0,0,0,0-tetraethyl s,s-methylene bis (phosphorodithioate).
3- **Lambda-cyhalothrin** (5% EC): A reaction product comprising equal quantities of (S) -2-cyano-3 phenoxybenzyl (z)-(1R3R)3-(2-chloro-3,3,3-trifluoro propenyl) -2,2 dimethyl cyclopropane carboxylate and (R) -a- cyno-phenoxybenzyl (Z) -(1S, 3S)-3-(2 chloro-3,3,3-trifluropropenyl)-2,2-dimethyl cyclopropane-carboxylate.
4- **Chlorfenapyr** (36% SC): 4-Bromo-2-(chlorophenyl) (ethoxymethyl)-5-(trifluoro-methyl)-1H- pyrrole -3- carbonitrile; 4-Bromo -2-(4-chlorophenyl)-1-(ethoxymethyl) -5- (trifluoromethyl) pyrrole -3-carbonitrile.
5- **Mineral oils** (Nat 1: (96 % E.C) was provided by Centeral Agricultural Pesticides Laboratory-Natural oil was applied at rate of 1L / fedan.
6- **Plant extracts** (Black cumin extract: An amount of 5g of black cumin seeds powder (*Nigella sativum* Linn.,Family: Ranunculaceae)

were extracted in 100 ml of absolute ethanol (75%). Extraction runs over night followed by filtration.

Experimental techniques:

1-Toxicity of tested compounds to adult female mites *T. urticae* and two predators *A. fallacis* and *P. persimilis*

The toxic effects of tested chemicals to the adult female mites, *T. urticae* and two predators were evaluated by the leaf disc dip technique according to Siegler, (1947). Mortality counts were recorded 24 hours after treatment. The natural mortality was corrected according to Abbott's formula (1925). Data were plotted on log dosage probit papers and statistically analyzed according to Litchfield and Wilcoxon (1949).

2-Effect of tested compounds on *T. urticae* eggs

The effectiveness of the tested compounds on *T. urticae* eggs was examined using the methods of Staal *et al.*, (1975).

Equations:

1- Abbott's formula (1925): was used to correct % mortality according to natural mortality:

$$\text{Mortality (\%)} = \frac{\%\text{Mortality of the treatment} - \%\text{Mortality of the control}}{100 - \%\text{Mortality of the control}} X100$$

2- The toxicity lines were statistically analyzed according to Litchfield and Wilcoxon (1949) as follows:- $Y = a + bx$

Where: Y= probit unit, a= constant value, b= slope of line and X= log concentration

3- Egg mortality: The percentage of mortality was calculated as follows :

$$\text{Egg mortality} = (a/b) \times 100$$

Where: a= unhatched eggs b= number of total eggs which counted before treatment with toxicant

4- Toxicity index of tested compounds were determined according to Sun (1950) as follows

$$\text{Toxicity index} = (LC_{50} \text{ of the most effective compound} / LC_{50} \text{ of the tested compound}) \times 100$$

5- Selectivity ratio of tested chemicals on predator mite *S.gilvifrons* was determined as follow according to Wilkinson (1976).

$$\textbf{Selectivity ratio (S.R.)} = \frac{LC_{50} \text{ of the compound on predator}}{LC_{50} \text{ of the compound on prey}}$$

$$\textbf{Selectivity index} = \frac{\text{S.R. of the compound on predator}}{\text{S.R. of the most selective compound}} \text{ X } 100$$

(Compound of the higher S.R. value)

7- Safety index of tested compounds on predator mite was determined according to Aref (1997) as follows:

$$\text{Safety index} = \frac{LC_{50} \text{ of tested compound on predator}}{LC_{50} \text{ of the least effective compound on predator}} \text{ x } 100$$

RESULTS AND DISCUSSION

1- Toxicity of tested compounds against adult females of two-spotted spider mite *T. urticae*:

Results in Table (1) indicated that, abamectin was the most toxic compound, followed by cyhalothrin and ethion to adult females of *T. urticae* with LC_{50} values of 0.1536, 39.2654 and 760.4663 ppm, respectively. While chlorfenapyr and Nat 1 have a moderate toxicity to adult females of *T. urticae* with LC_{50} values of 3078.4039 and 4508.8255 ppm, respectively. On the other hand black cumin extract was the least toxic to adult females of *T.urticae* with LC_{50} value 47930.1847 ppm. The data in Table (1) showed that abamectin as an acaricide was more toxic to adult females of *T.urticae* than the other compounds. Slope values (Table 1) indicated that ethion has the highest slope value (0.8334), while abamectin has the lowest one (0.1573). Nat1, chlorfenapyr, black cumin extract and cyhalothrin have slope values of 0.4884, 0.3330, 0.3175 and 0.2596 respectively.

Concerning the toxicity index at LC_{50} level, the data in Table (1) confirmed that abamectin was the most toxic compound to adult females of *T.urticae* with toxicity index of 100, followed by a drastic drop in toxicity index in case of cyhalothrin with value of 0.3912, while ethion, chlorfenapyr, Nat1 and black cumin extract have poor toxic effects to adult females of *T. urticae* of toxicity indexes of 0.0202, 0.0050, 0.0034 and 0.0003 respectively. The obtained results are in agreement with the result obtained by Ismail *et al.* (2006 and 2007).

2- Toxicity of tested compounds to eggs of two-spotted spider mite *T. urticae*:

Results in Table (1) indicate that, cyhalothrin was the most toxic compound, followed by abamectin against the egg stage of spider mite *T.urticae* with LC_{50} values of 0.9918 and 2.6385 ppm. While ethion, chlorfenapyr and Nat1 have a moderate toxicity to egg stage of *T.urticae* with LC_{50} values of 13.7885, 42.1816 and 798.2256 ppm, respectively. Black cumin extract was the least toxic one to eggs of *T.urticae* of LC_{50} value of 34745.7861 ppm.

Slope values (Table 1) data indicated that Nat1 has the highest slope value (0.3307), while black cumin extract, chlorfenapyr and ethion have slope values of 0.2793, 0.2482 and 0.2130, respectively. Cyhalothrin and abamectin have the lowest slope values (0.1722 and 0.1546). In general the slopes of all compounds listed are considered of low value indicating a case of heterogeneity in the response of mite egg population towards these compounds.

These results can be supported with those obtained by several investigators. Ibrahim and Yee (2000) reported that 1-day old eggs of two – spotted spider mite *T.urticae* was more susceptible for Andalin than 2 and 3 days old eggs Keratum (2001) indicated that fenpyroximate was the most potent compound against eggs of *T.urticae*, followed by Vertimec. Also, Hosny *et al.* (2003) indicated that abamectin was highly toxic to eggs of *T.urticae* and fenpyroximate had the next position in integrated mite management. Also they indicated that cypermethin was one of the most effective compounds on eggs of *T.urticae*. Ismail (2006 and 2007) indicated that abamectin was the most toxic compound against the egg stage of *T.urticae* with LC_{50} value of 2.88 ppm.

Table (1): Toxicity of different compounds to eggs and adult females of two-spotted spider mite *T. urticae* and two predators *A. fallacis* and *P. persimilis*

Compounds	Adult female of *T. urticae*			eggs of *T. urticae*		
	LC_{50} (ppm)	Toxicity Index*	Slope value	LC_{50} (ppm)	Toxicity Index*	Slope value
Abamectin	0.1536	100	0.1573	2.6385	37.5895	0.1546
Ethion	760.4663	0.0202	0.8334	13.7885	7.1930	0.2130
Chlorfenapyr	3078.4039	0.0050	0.3330	42.1816	2.3513	0.2482
Cyhalothrin	39.2654	0.3912	0.2596	0.9918	100	0.172
Nat 1	4508.825	0.0034	0.4884	798.2256	0.1243	0.330
Black cumin	47930.184	0.0003	0.3175	34745.78	0.0029	0.279

3- Toxicity of tested compounds to adult females of predatory mites:

3-1.: Predatory mits *A. fallacies.*

The data in Table (2) showed that abamectin was the most effective compound with LC_{50} value of 0.0001 ppm, followed by cyhalothrin and ethion with LC_{50} values of 30.1343 and 52.3769 ppm respectively. Chlorfenapyr and Natl have a moderate toxic effect with LC_{50} value of 306.0944 and 943.8534 ppm, respectively. Black cumin extract was the least toxic compound to adult females of *A.fallacis* with LC_{50} value of 1599.1403 ppm. Based on LC_{50} values in Table (2) the data showed that abamectin and cyhalothrin were more toxic to adult females of *A.fallacis* than ethion and chlorfenapyr which black cumin extract was the least toxic one. The mineral oil Natl was more toxic than black cumin extract. Refering to Table (2) it appears that Natl and black cumin extract have the highest slope values (2.7692 and 2.6878), Followed by chlorfenapyr with slope value of 2.1681 ppm. Ethion and cyhalothrin have slope values of 1.6409 and 1.2810 respectively, while abamectin had of the lowest slope value (0.9477).

Table (2): Toxicity of different compounds to adult females of two predators *A. fallacis* and *P. persimilis*

Compounds	*A.fallacis*			*P.persimilis*		
	LC_{50} (ppm)	Toxicity Index*	Slope value	LC_{50} (ppm)	Toxicity Index*	Slope value
Abamectin	0.0001	100	0.9477	0.0001	100	1.2524
Ethion	52.3769	0.0002	1.6409	42.9454	0.0002	2.2711
Chlorfenapyr	306.0944	0.00003	2.1681	241.0384	0.00004	2.8327
Cyhalothrin	30.1343	0.0003	1.2810	24.6691	0.0004	2.0219
Nat 1	943.8534	0.00001	2.7692	1532.4176	0.000007	2.2408
Black cumin	1599.140	0.000006	2.6878	1329.8505	0.000008	2.9344

The data in Table (2) confirmed that abamectin was the most toxic compound to adult females of *A.fallacis* a with toxicity index of 100, followed by a drastic drop in toxicity index, in case of cyhalothrin and ethion with toxicity indexes of 0.0003 and 0.0002 respectively. Chlorfenapyr and Natl have low toxic effect to adult females of *A.fallacis* with toxicity indexes of 0.00003 and 0.00001 respectively, while black cumin extract was the least toxic compound to adult females of *A.fallacis* with toxicity index of 0.000006. In fact the toxicity index (Sun, 1950) of any toxic compound was suggested mainly to pool different information about this compound against different mite species and mite stages by comparing their LC_{50} values. The final values concluded from their

calculation is the efficiency of the compound tested in integrated pest management.

3-2.: Predatory mit *P. Persimilis.*

The data in Table (2) showed that abamectin was the most effective compound on adult females of predator mite *P.persimilis* with LC_{50} of 0.0001ppm, followed by cyhalothrin and ethion with LC_{50} values of 24.6691 and 42.9454 ppm respectively. Chlorfenapyr had a moderate toxic effect with LC_{50} of 241.0384 ppm, while black cumin extract and Nat1were the least toxic compounds to adult females of *P.persimilis* of LC_{50} values of 1329.8505 and 1532.4176 ppm respectively. Based on LC_{50} values in (Table 2) the data showed that abamectin, cyhalothrin and ethion were more toxic to adult females of *P.persimilis* while black cumin extract and Nat1 were the least toxic compounds.

Black cumin extract and chlorfenapyr have the highest slope values (2.9344 and 2.8327) followed by ethion and Nat1with slope values of 2.2711 and 2.2408 respectively. Cyhalothrin has slope value of (2.0219), while abamectin had the lowest slope value (1.2524).

Concerning the toxicity index at LC_{50} level, the data in Table (2) confirmed that abamectin was the most toxic compound to adult females of *P.persimilis* with toxicity index of 100, followed by a drastic drop in toxicity index in case of cyhalothrin and ethion (0.0004 and 0.0002, respectively). Chlorfenapyr has low toxic effect to adult females of *P.persimilis* with toxicity index of 0.00004, while black cumin extract and Nat1 were the least toxic compounds to adult females of *P.persimilis* with toxicity indexes of 0.000008 and 0.000007, respectively.

The safety index, selectivity index and selectivity ratio values in Table (3) showed that black cumin extract is the most safe compound to adults of predatory mite *A.fallacis* with safety index of 100, followed by Nat1with safety index (59.023), while chlorfenapyr, ethion and cyhalothrin were of moderate safety effect on adults of *A.fallacis* with safety indexes of 19.141, 3.275 and 1.884 respectively. On the ather hand, abamectin was of the least safe on adult predatory mite *A.fallacis* with safety index of 0.000006.

The data in Table (3) indicated that in most cases, there was no apparent difference between safety indexes of the same compound against the predatory mite *P.persimilis* with an exception case of Nat1, the safest compound to adults of predatory mite *P.persimilis* with safety index of 100, followed by black cumin extract with safety index of 86.781. Chlorfenapyr,

ethion, cyhalothrin and abamectin were safe on adults of predatory mite *P.persimilis* (15.729, 2.802, 1.609 and 0.000007, respectively).

These results confirmed that cyhalothrin appeared to be of high selective effect on predatory mites *A.fallacis* and *P.persimilis* with selectivity ratio of 0.767 and selectivity index of 100 for *A.fallacis*, while for *P.persimilis* with selectivity ratio of 0.628 and selectivity index of 100. Nat1, cyhalothrin, ethion and black cumin extract have a moderate selective effect with selectivity ratio of 0.209, 0.099, 0.069 and 0.033 for *A.fallacis* and 0.339, 0.078, 0.56 and 0.028 for *P.persimilis* respectively and selectivity index values of 27.277, 12.959, 8.974 and 4.347 for *A.fallacis* and 54.097, 12.463, 8.989 and 4.416 for *P.persimilis* respectively. Abamectin has the lowest selective effect with selectivity ratio of 0.000651for the two predators and selectivity index of 0.0848 and 0.1036 for the two predators *A.fallacis* and *P.persimilis*. The selectivity index is considered the most precise value that indicates how far the compound behaves toward the two adult species of mites (predator and phytophagous one). In other words, the most compound against the predator and the same time the most toxic to the prey mite is the most suitable compound that must be advised to be involved in an integrated pest management.

Table (3): Toxicity parameters of different compounds to adult female mites of *A. fallacis* and *P. persimilis* :

Compounds	*A. fallacis*			*P. persimilis*		
	Safety index	Selectivity ratio(S.R)	Selectivity index	Safety index	Selectivity ratio(S.R)	Selectivity index
Abamectin	0.000006	0.000651	0.084826	0.000007	0.000651	0.103619
Ethion	3.275316	0.068875	8.974467	2.802461	0.056472	8.988619
Chlorfenapyr	19.14185	0.099433	12.956229	15.729289	0.078299	12.462850
Cyhalothrin	1.884406	0.767452	100.00	1.609816	0.628266	100.00
Nat 1	59.022551	0.209335	27.276583	100.00	0.339871	54.096643
Black cumin extract	100.00	0.033364	4.347362	86.78120	0.027746	4.416206

It is interesting to find out that cyhalothrin has the highest selectivity index and highest selectivity ratio in spite of its low safety index value. The present results, therefore recommend this compound in IPM programs.

The selectivity of a compound is more important than its safety for predatory mites due to the presence of the two organisms on the same host plant. Nat1, chlorfenapyr, ethion and black cumin were the next compounds in their selectivity ratio values, while abamectin had the least value (0.000651).

Reviewing the above results about the toxic effect of different tested compounds to adult females of predatory mites *A.fallacis* and *P.persimilis*, the following points could be concluded:

1. Nat1 and black cumin extract are the safest compounds to adults of predatory mites *A.fallacis* and *P.persimilis*.
2. Cyhalothrin has the highest selectivity index and highest selectivity ratio in spite of its safety values, so it can be recommended in IPM programs.
3. Nat1, chlorfenapyr and ethion were the next compounds after cyhalothrin in their selectivity ratio values, but Nat1 has a special position and considered promising oil in mite control programs.
4. Abamectin has the least values of selectivity index and selectivity ratio and it's low safety index make us to keep it in mined under certain conditions (in case of rare predators with high level of phytophagous mites).

The present data are accessional in agreement with that of others investigators who showed the toxicity of the tested compounds against adult females of predatory mites. El-Adewy *et al.* (2000) found that the value of the general selective toxicity ratio recommended fenpyroximate as the safest acaricide for mite predatory *S.gilvifrons* as compared to its prey *T.urticae*. El-Beheiry *et al.* (1987) found that cypermethrin 10% EC was less toxic than Lanate 90% WP to predatory mite *A.gossipi*. The tested mineral oil was appeared to be of high safety index that means it of low toxicity against the predatory mite.

Khan *et al.* (2005) found that after 24 hrs, higher mortalities were caused by Ordoval (100%) while lower by Apollo (5.49%), Confidor (6.43%), Masai (2/35%) and ME605 (13.66%). Data recorded after 72 hrs showed that Metasytox and Telmio also caused 100% mortality. Based on the toxicity level, Metasystox, Ordoval and Telmion were slightly toxic, while Apollo, Confidor Masai and ME605 were harmless to predatory mite *Typhlodromus pyri.* Cloyed *et al.* (2006) found that both rates of chlorfenapyr and spiromesifen and the single rate of bifenazate were not harmful to *Neoseiulus californicus* with percent live values 85% for chlorfenapyr and 95% for spiromesifen and subsanially toxic to *P.persimilis* with percent live mite values of 63% for all the miticides tested. Saenz *et al.* (2007) showed that, fenpyroximate was considered slightly persistent for *Galendromus occidentalis* and *P.persimilis*, while abamectin was also slightly persistent for *P.persimilis* only.

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الملخص العربى

المعالجة المتكاملة للاكاروس.

١- تقييم بعض المركبات ضد العنكبوت الاحمر (تترانيكس أورتيكا) والاكاروسات المفترسه (امبليسيس فالاسيس ، فيتوسيلس بيرسيميلس).

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لقد اجريت الدراسة الحالية لتقييم التاثير السام لستة مركبات من مجاميع مختلفه، ثلاثة مركبات اكاروسية (ابامكتن، اثيون، كلورفينابير) ومركب بيروثرويدى (سيهالوثرين) وزيت معدنى واحد (نات واحد) والمستخلص النباتى زيت حبة البركة ضد البيض والاناث البالغة للاكاروس النباتى (تترانيكس أورتيكا) والاناث البالغة للاكاروسات المفترسه (امبليسيس فالاسيس ، فيتوسيلس بيرسيميلس) وذلك باستخدام القرص الورقى.

واظهرت النتائج ان المبيد الاكاروسى ابامكتن له وضعا خاصا فى المكافحة الكيمياوية للاكاروس النباتى او فى برامج المكافحة المتكاملة للاكاروس وذلك بسبب تاثيره السام العالى ومنحنى سميته العالى بين المركبات المختبره بينما المستخلص النباتى كان اقل المركبات سمية على الاناث البالغة للاكاروس النباتى. وكان مركب السيهالوثرين والابامكتن يحتلان وضعا خاصا فى التاثير على بيض الاكاروس النباتى ويعتبراً افضل المركبات والتى لها اهمية خاصة فى برامج المعالجة المتكاملة بينما الزيت المعدنى كان اكثر سمية على طور البيض للاكاروس بالمقارنه بالمستخلص النباتى. اظهرا كلا من الزيت المعدنى والمستخلص النباتى اكثر المركبات اماناً على الاناث البالغة للاكاروسات المفترسه. بينما اظهر مركب السيهالوثرين اعلى منحنى اختيارية واعلى نسبة فى الاختيارية ويسبب ارتفاع قيمة منحنى الامان له فيمكن ان ينصح به فى برامج المكافحة المتكاملة. الزيت المعدنى والميد كلورفينابير والايثون كانت المركبات التاليه بعد المركب البيروثرويدى فى قيم الاختيارية ولكن الزيت المعدنى كان له وضعاً خاصاً وواعد فى برامج المعالجة. مركب الابامكتن مثل القيمة الاخيرة فى منحنى الاختيارية ونسبتها ومنحنى امانه المنخفض يجعلنا وضعه تحت الظروف الضروريه (فى حالة اطلاق المفترسات تحت معدل الاكاروس العالى).