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Field and Laboratory Study to Compare the Effect of some Compounds on *Tetranychus urticae* (Koch) and *Tetranychus cucurbitacearum* (Sayed) on Soybean Plants

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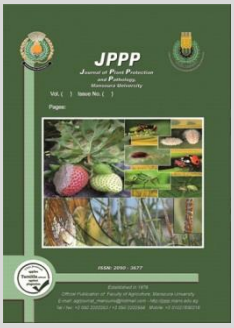

ABSTRACT

Current experiments were conducted to assessment, the relative toxicity of four chemicals and action mechanism for two insecticides (Abamectin and Ethion), and two plant oils; *Allium sativum* (Liliaceae) oil and *Melia azedarach* (Meliaceae) oil against females adult and eggs of two spotted spider mite *T. urticae* and *T. cucurbitacearum*. In addition to evaluation the side effects of "sub-lethal dose" of these chemicals on "biological-aspects" for the tested insect stages "spider mites" using standardized method for bioassay. Sub-lethal doses effects of these chemicals on some biological-aspect were evaluated. Data obtained resulted that, abamectin gave highly toxic compound and ethion was in the 2nd rank, while *A. sativum* oil and *M. azedarach* oil showed the lower-toxic against females-adult of *T. urticae*, and *T. cucurbitacearum*. Also, the results showed that, the two compounds "abamectin and ethion" showed highly-toxic ovicide on egg-stages of *T. urticae* and *T. cucurbitacearum*, while *A. sativum* oil and *M. azedarach* oil, appeared least-toxic against eggs-stages of *T. urticae*, and *T. cucurbitacearum*. The results also, indicated that the high reduction percentage in eggs laying capacity with (63.19 and 62.94%) were found when females-adult of *T. urticae* and *T. cucurbitacearum*, treated with "LC_{50} value" of abamectin, while the lowest reduction (6.63 and 11.64 %) was obtained in case of the treatment with LC50 of *M. azedarach* of them. Abamectin and ethion were most effect against motile-stages, whilst *M. azedarachtin* oil, showed least-effect against motile-stages of *T. urticae* and *T. cucurbitacearum*, in field condition.

Keywords: Abamectin, Ethion, *Tetranychus urticae*, *Tetranychus cucurbitacearum*.

INTRODUCTION

Mites have always attracted considerable interest. The Infestation by mites caused a great damage to these infested plants followed by a secondary infestation by various pathogens such as virus, bacteria and fungi. The two-spotted spider-mites "*Tetranychus urticae"* and "*Tetranychus cucurbitacearum"* belonging to family "Tetranychidae" Which in turn contains the harmful mite species. It is a pest serious for many greenhouse plants and ornamental plants grown in nursery and field crops (Johnson and Lyon, 1991). Great attention is offered to survey and control these pests to protect the crops and then to minimize the loss in agricultural economy. The primary methods of pests control used by chemicals in ornamental-plant, Hodges, and Haydu, 1997. The two-spotted spider mites, *Tetranychus urticae* and *T. cucurbitacearum*, they are one of the main pests that attack various agricultural crops including the soybeen, vegetables and ornamentals Migeon, and Donkeld, 2007. The spider-mites insert their piercing and sucking-mouthparts in plant-tissues and they prefer feeding on lower-leaf surface, Attia *et. al.* 2013, it causes plant infection by introducing toxic substances "phytotoxic" that damage and destroy plant-tissues and producing necrotic-spots on leaf-surface of infested plants. Excessive use of insecticides against this pest along with its high reproductive potential, short life cycle and non-dishonorable mating regime has led to resistance development, Van leeuwen, *et al.*, 2009. Because of the problems caused by the indiscriminate use of pesticides, environmental pollution and pest resistance to them, the use of pesticides must be reduced, and the pesticides should be more selective, specialized and more sophisticated with modern control methods.

The experiments were carried out to study the effect of tested pesticides on spider-mites, *Tetranychus urticae* and *Tetranychus cucurbitacearum*, on variety of soybean-plant.

MATERIALS AND 'METHODS

1. Cultures technique.

Prey culture:

The prey special, the two spotted spider-mites *Tetranychus urticae*, koch., and *T. cucurbitacearum* "Acarina; Tetranychidae" were rearing according to Dittrich, 1962.

2- Tested compounds:

Using of four compound formulations and dosages calculated according to basis of ppm of active ingredient.

Abamectin 1.8 % : Chemical name (IUPAC name): Abamectin; containing (80%) avermectin, B,a. ("5-0-deinethyl-avermectin-Aia") at minimum and (20%) avermectin, B,b. {"5-0-demethyl-25-de-(l-methyl-propyl)-25-(l-methylethyl) avermectin, A,a."} at maxmum. It was supplied by Merck Company, Inc., Rahway, New Jersey, U.S.A

Ethion 50 % E.C (0, 0, 0, 0- tetraethy1 s, s-methylene-bis (Phosphorodi-thioate).50% E.C.)**.** It was supplied by El- Help Pesticides and Chemicals Company, Egypt.

A.sativum oil Source: It was supplied by Merck Company, Inc., Rahway, New Jersey, U.S.A.

***Melia azedarach* oil Source**: El-Help Pesticides, Chemicals Com.-Egypt.

3. Experimental techniques;

Discs Preparations:

The soybean-discs cutting by use of cork-borer, so that, They are divided by the midrib and then, lower-surface placed upper on the soybean soaked by water wool-bad in Petri-dishes. Disc size Differs depend on experiment nature.

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In predation-experiments, required numbers of *T. urticae,* and *T. cucurbitacearum,* eggs were laid out on each disc, and the discs left for 1hr., and then, they checked to determine if the eggs were infected during transferring. The infected-eggs replaced before the predators and introduced to these discs. The experiments of leaf-discs accomplished at (25±2°C) with photoperiod 16hrs., unless otherwise stated.

Prey eggs production:

The red spider-mite eggs to using prey made according to (Giboney, 1981).

4- Assessment technique of tested-compound:

Most important consideration with any bioassay technique is that variation between tested animals and between environmental conditions before during or after testing is given by Busvine (1971).

The tested chemicals toxicity against adult-females of two spotted spider-mites *T. urticae,* and *T. cucurbitacearum*.

The toxic-effect of tested-chemicals compounds of two spotted spider-mite *T. urticae* were evaluated by leaf-discs of dip-technique according to Siegler 1947, and the counts of mortalities were taken about 24hrs, after-treatment. The "Abbott's formula" 1925"., was used in mortality correct.

The tested chemicals toxicity against eggs of two spotted spider-mites *T. urticae,* and *T. cucurbitacearum*.

The red eggs of spider-mites were used as prey and obtained by placing "10 adult-females" of *T .urticae,* and *T. cucurbitacearum,* were made according to Giboney 1981.

Compound-residues effect on *T. urticae,* eggs and *T. cucurbitacearum* depositions and eggs-hatching.

The residual-effect assays of tested-chemical were at (LC_{25} level) on the prey mite adults, these technique were made according to Keratum, *et al.* 1994.

5- The field experiment:

In summer seasons (2019 and 2020), two experiments conducted in farm of Sakha, Agric., Res., Station, Kafr El Sheikh Gov. in Egypt, the efficiency was evaluated of tested-chemicals against spider-mite, *T. urticae,* and *T. cucurbitacearum,* attacking soybean-plants varieties. Each plot (1/100/Feddan) in completely-randomized-blocks design. Each treatment was replicates four times. The all of tested-chemicals were applied at ½ of their recommended-rates by using "knapsack-sprayer"/one nozzle, with water using for diluting compounds "200 liter/Fadden". The sample "10-soybean-leaves" collected randomly before and after treatment of each plot, with 2-days intervals, and one week later.

6- The statistical analysis:

Reduction% was estimated/treatment according to "Handerson and Tilton 1955" and "Duncan 1955" multiple-range-tests/5% level was used for significant-differences between treatments. Insecticides effect was calculated according to "Abbott formula 1925" and data obtained were calculated with variance analysis and mean values compared according to "Duncan's-test" by using SPSS program. Data obtained of insecticides effects in the filed were corrected with "Henderson &Tilton 1955" formula and "Duncan 1955" multiple-range-tests/5% level, was used for determined significant-differences between treatments.

RESULTS AND DISCUSSION

1- The Adult females of two spotted spider-mite *T. urticae,* and *T. cucurbitacearum,* on leaf-discs of soybean as affected by toxicity of tested compounds:

The current experiment was conducted to assessment some chemicals, Abamectin, Ethion, *A. sativum* oil and *Melia azedarach* oil) against adult females of *T. urticae*.

Data obtained in (Table 1) showed that, abamectin compound appear highly toxic against adult-females of *T. urticae,* and *T. cucurbitacearum,* the "LC_{50} values" was (0.6 and 1.30ppm), followed by ethion, the "LC_{50} values" was (18.44 and 23.52ppm), respectively, while *A. sativum,* and *M. azedarach,* oils showed the lower toxic against adult-females of *T. urticae,* and *T. cucurbitacearum,* the "LC_{50} values" as 123.73, 144.22, 158.32 and 163.24ppm, respectively.

According to the toxicity-index at "LC_{50} level", obtained data in (Table 1) indicated that, "abamectin" showed more-toxic against adult-females of *T. urticae,* and *T. cucurbitacearum,* the toxicity-index was 100.0 followed by "ethion" the toxicity-index counted (3.25 and 5.52), while *A. sativum,* and *M. azedarch,* oils were lower toxic against adult-females of *T. urticae,* and *T. cucurbitacearum,* with toxicity-indexes (0.48, 0.90, 0.37 and 0.79) respectively.

Tarikul Islam (2018). Mentioned that, "abamectin" was the most-toxic as acaricide "Lc_{50} values" counted (0.432, 0.342 and 0.324mgl^{-1}) on country bean papaya and jute leaf-discs for *T. urticae,* respectively, at 24hr. after treatment application, followed by "azadirachtin, emamectin benzoate, spinosad and hexythizox" respectively. Habashy (2018), in Egypt, searched in the "ability" and "stability" of *Allium sativum linn*., aqueous-extract against two spotted spider-mite, *Tetranychus urticae*. Data showed that the maximum mortality value was 83.33% after 7 days, for *T. urtecae*. Khairia *et al* (2019) resulted that abamactin 1.8% was the most effective acaricides followed by buprofezin, abamactin 5% chlorfenapyr, hexythiazox and fenpyroximate, respectively, to control of two-spotted spider-mite *T .Urticae,* infesting pepper and eggplant plants during 2016 and 2017, and data showed significant reduction under field condition.

Table 1. Adult-females of tow spotted spider-mite *T. urticae,* and *T. cucurbitacearum,* on soybeen leaf-discs as affected by the toxicity of different compounds.

Compound	*T. urticae*		*T. cucurbitacearum*	
	LC_{50} (PPM)	Toxicity index	LC_{50} (PPM)	Toxicity index
Abamectin	0. 6	100	1.30	100
Ethion	18.44	3.25	23.52	5.52
A. sativum oil	123.73	0.48	144.22	0.90
M. azedarach oil	158.32	0.37	163.24	0.79

2- The toxicity of tested-chemicals against eggs of two spotted spider-mite *T. urticae,* and *T. cucurbitacearum:*

The mortalities were corrected by "Abbott's formula 1925" depending on "LC50 values" and data results in (Table 2), showed that, abamectin was more toxic compound followed by ethion, to eggs-stage of spider-mite *T. urtecae,* and *T. cucurbitacearum,* the "LC50 values" were (1.4 and 0.75ppm) respectively, while ethion was moderately toxic to eggs-stage of *T. urticae,* and *T. cucurbitacearum,* the "LC50 values" were (22.43 and 17.55ppm) respectively. The *M. azedarach* oil appears lower-toxic against eggs-stages of *T. urtecae,* and *T. cucurbitacearum,* with "LC50 values" (219.75 and 153.64ppm) respectively. According to toxicity-index at LC50 levels, data resulted in (Table 2) concluded that, abamctin showed more-toxic against eggs-stage of *T. urticae,* and *T. cucurbitacearum,* with toxicity-index 100.00 %, while ethion was moderately-toxic to eggs-stage of *T. urticae,* and *T. cucurbitacearum,* with toxicity-indexes (6.24 and 4.27%) respectively. The *A. sativum* and *M. azedarach* oils were lower-toxic to eggs-stages of *T. urticae,* and *T. cucurbitacearum,* with toxicity-indexes (0.84, 0.679, 0.637 and 0.488%) respectively.

Seliman, and Abd El-Rahman, 2015, recorded that Cyhalothrin, was more-toxic followed by fenpyroximate, to eggs-stages of *T. urticae*. Lubna, *et al*. 2017, studied the effect of 5 bioinsecticides including, oils of neem 500ml, cooking 750 ml, linseed 750ml, hing 290gm and soybeen 750ml/acre., against whitefly, obtained data resulted, oils of neem 63.27% and soybeen 62.01% appears most reducing followed by hing 58.25%, cooking oil 57.18% and linseed oil 55.24% respectively.

Table 2. The toxicity of tested- chemicals to eggs-stages of tow spotted spider-mite *T. urticae,* and *T. cucurbitacearum,* on soybeen leaf-discs affected by toxicity of different compounds.

Compound	*T. urticae*		*T. cucurbitacearum*	
	LC_{50} (PPM)	Toxicity index	LC_{50} (PPM)	Toxicity index
Abamectin	1.4	100	0.75	100
Ethion	22.43	6.24	17.55	4.27
A. sativum oil	166.33	0.84	110.34	0.679
M. azedarach oil	219.75	0.637	153.64	0.488

3- The effect of tested-chemicals-residues on deposition of eggs of adult-females of *T. urticae:*

The mean-number of eggs deposited by adult-female of mites, *T. urticae,* and *T. cucurbitacearum,* were treated by different compounds, the result obtained in Tables 3 and 4, indicated that, abamectin was more-toxic compound on egg-deposition with (63.19 and 62.94%), followed by ethion, was moderate-effect on (58.12 and 48.04%), respectively, while the *A. sativum,* and *M. azedarach,* oils showed lower-effect, and were effective in reducing of mite-fecundity recorded 20.83, 23.14% and 6.63, 11.64%, respectively. Different researched were conducted on efficacy of some chemicals on mites-biology and data indicated that, the chemicals were positively-effects on egg-deposition of mites.

The current study was simulated with field-condition where, mites will exposure to pesticide-residues on leaves of tested plant as "contact or stomach poison" during feed on contaminated-cells. Premalatha *et al* 2017, evaluated the acaricidal activity of aqueous extract of 20 plant species at 10 percent concentration on red spider mite, *T. urticae* under laboratory condition by using the leaf disc method, they resulted, the aqueous extract of sesbania grand flora caused the highest mortality of 94.43 percent of *T. urtecae* at 72 hours after treatment which was statistically superior to all other treatments. Keratum and Ibrahim 2018, mentioned that the cyhalothrin, was highly-effective on egg-depositions by adult-females of *T. urticae,* followed by ethion, and abamectin, while the black-cumin extract showed the lower-effective. As well as, the results showed that, "cyhalothrin" and "abamectin" were highly-effective, which decreased egg-hatchability of *T. urticae,* followed by "ethion", while black-cumin extract was lower-effective on egg-hatchability. Habashy, 2018, studied the storage-periods effect of six-concentrations of aqueous-garlic extract on spider-mite *T. urticae,* and he reported that, the extracts activity decreased the times for all tested-concentrations and four-weeks later, it lost activity about (30%), and extract showed significant-reduce of egg-deposition and hatchability of spider-mite *T. urticae*.

Table 3. Effect of different compounds residues on egg-deposition of spider-mite ***T. urticae.***

Compounds	No. of eggs deposited/5 adults					Mean
	1st day	2nd day	3rd day	4th day	5th day	
			T. urticae			
Control	18.77±0.75[a]	21.00±0.33[a]	24.75±0.55[a]	27.50±0.13[a]	31.25±0.57[a]	24.65±0.46[a]
Abamectin	4.50±0.22[e]	6.50±0.50[e]	9.25±0.50[e]	11.00±0.64[e]	14.50±0.77[e]	9.15±0.49[e]
Ethion	6.75±0.34[d]	7.00±0.45[d]	10.25±0.86[d]	13.00±0.78[d]	16.05±0.37[d]	10.61±0.56[d]
A. sativum oil	13.50±0.42[c]	16.75±0.87[c]	19.00±0.50[c]	22.50±0.63[c]	26.50±0.48[c]	19.65±0.58[c]
M. azedarach oil	16.00±0.75[b]	19.25±0.77[b]	23..75±046[b]	26.50±0.88[b]	30.50±0.92[b]	23.20±0.75[b]
			T. cucurbitacearum			
Control	19.00±0.66[a]	22.50±0.37[a]	26.25±0.77[a]	30.75±0.88[a]	33.75±0.88[a]	26.45±0.71[a]
Abamectin	5.00±0.74[e]	7.50±0.55[e]	10.00±0.46[e]	13.25±0.34[e]	15.00±0.85[e]	10.15±0.58[e]
Ethion	7.00±0.88[d]	11.50±0.66[d]	14.00±0.05[d]	17.75±0.76[d]	29.75±0.67[d]	16.00±0.69[d]
A. sativum oil	13.00±0.44[c]	16.00±0.47[c]	20.50±0.57[c]	25.50±0.78[c]	28.25±0.96[c]	20.65±0.64[c]
M. azedarach oil	16.25±0.65[b]	19.50±0. 38[b]	23.00±0.70[b]	27.25±0.91[b]	31.50±0.65[b]	23.50±0.65[b]

Table 4. Reduction% in eggs-laying capacity of *T. urticae* 5 female due to compounds.

Compounds	Reduction%					Mean
	1st day	2nd day	3nd day	4th day	5th day	
			T. urticae			
Abamectin	70.69	69.04	62.62	60.00	53.60	63.19
Ethion	64.03	66.66	58.58	52.72	48.64	58.12
A. sativum oil	28.07	20.23	23.23	18.18	14.44	20.83
M. azedarach oil	14.75	8.33	4.04	3.63	2.40	6.63
			T. cucurbitacearum			
Abamectin	73.68	66.66	61.90	56,91	55.55	62.94
Ethion	63.15	48.88	46.66	42.27	39.25	48.04
A. sativum oil	31.57	28.88	21.90	17.07	16.29	23.14
M. azedarach oil	14.47	13.33	12.38	11.38	6.66	11.64

4- The effect of tested-chemicals on motile-stages of spider-mite, *T. urticae.*

The mean number of eggs-deposited by adult-female mites, *T. urticae,* and *T. cucurbitacearum,* were treated by different compounds, the result obtained in Tables 5 and 6, indicated that, abamectin was more-toxic compound reduction in 2019 and 2020 seasons, with (64.64 and 62.73%) respectively, of *T. urticae,* and similarly effect on *T. cucurbitacearum,* with (64.09 and 65.06%) respectively. The *M. azedarach,* oil was lower-effect on that characters and were similarly effect in reduction of mite-fecundity with 38.36, 43.37% and 38.02, 42.40% respectively. Hala *et al.* (2021) found that, Abamectin and Fenpyroximate exhibited the highest acaricidal activity, followed by Buprofezin and anti-insect Cifarilli sprayer was more effective to control *T. urticae* on cotton.

Table 5. Effect of tested compounds on motile stages of spider mite, *T. urticae* on soybean plants in the field.

Compounds	No. of mites before treatment	No. of mites after treatment (weeks)			
		1st week	2nd weeck	3rd weeck	4th weeck
		Season 2019 *T. urticae*			
Abamectin	198.10	15.33	44.36	78.45	86.23
Ethion	190.00	34.72	46.70	72.92	83.82
A. sativum oil	185.75	53.93	60.93	78.37	91.47
M. azedarach oil	199.33	71.28	81.47	98.16	102.36
Control	275.50	258.81	216.72	185.48	177.91
		Season 2019 *T. cucurbitacearum*			
Abamectin	202.00	14.32	36.86	66.51	80.53
Ethion	195.32	36.21	50.63	68.75	81.72
A. sativum oil	187.88	48.55	63.85	75.45	94.63
M. azedarach oil	203.77	76.57	84.74	96.45	105.64
Control	275.44	248.74	225.65	182.63	173.57
		Season 2020 *T. urticae*			
Abamectin	198.10	13.88	38.55	73.55	81.33
Ethion	190.00	32.54	41.63	68.45	77.25
A. sativum oil	185.75	48.94	56.44	75.44	99.34
M. azedarach oil	199.33	67.77	76.33	90.63	153.86
Control	275.50	252.75	216.92	191.31	178.89
		Season 2020 *T. cucurbitacearum*			
Abamectin	202.00	16.00	31.75	61.66	83.64
Ethion	195.32	30.66	46.86	66.77	76.98
A. sativum oil	187.88	42.34	59.12	68.56	90.00
M. azedarach oil	203.77	70.57	80.86	91.77	98.55
Control	275.44	251.12	227.54	187.74	168.88

Table 6. Reduction percentage in eggs laying capacity of *T. urticae*/ 5 females due to compounds on soybean plant in the field.

Compounds	% reduction				General mean
	1st week	2st weeck	3st weeck	4st weeck	
Season 2019 *T. urticae*					
Abamectin	92.67	75.17	48.76	41.99	64.64
Ethion	80.91	69.25	44.05	32.95	56.78
A. sativum oil	73.77	65.36	41.35	28.64	52.28
M. azedarach oil	61.42	47.17	25.49	19.36	38.36
Season 2019 *T. cucurbitacearum*					
Abamectin	92.04	77.39	49.44	37.52	64.09
Ethion	79.51	68.40	46.81	35.48	57.55
A. sativum oil	72.29	59.78	41.10	24.60	49.44
M. azedarach oil	57.77	48.42	27.24	18.66	38.02
Season 2020 *T. urticae*					
Abamectin	92.36	75.28	46.53	36.77	62.73
Ethion	81.33	72.17	48.12	37.38	59.75
A. sativum oil	71.28	61.41	41.51	17.64	47.96
M. azedarach oil	63.00	57.10	34.52	18.87	43.37
Season 2020 *T. cucurbitacearum*					
Abamectin	91.36	80.98	55.43	32.50	65.06
Ethion	82.88	70.97	50.09	35.75	59.92
A. sativum oil	75.54	61.92	46.72	21.91	51.52
M. azedarach oil	62.25	51.98	34.24	21.16	42.40

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دراسة حقلية ومعملية لمقارنة تأثير بعض المركبات للأكاروسين *Tetranychus urticae* و *Tetranychus cucurbitacearum* علي نباتات فول الصويا

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قد أجريت التجارب المعملية والحقلية لتقييم التأثير السام لأربع مركبات (أثنين مركبات اكاروسية وهى الابامكتين والاثيون) وأثنين من الزيوت النباتيه (زيت الثوم وزيت الزنزلخت) ضد الإناث البالغة للأكاروس الأحمر ذو البقعتين *Tetranychus urticae* و *Tetranychus cucurbitacearum* واختبار التأثير الابادى لهذه المركبات على طور البيض ايضا ، كما اختبرت ضد الإناث البالغة للأكاروس علي نباتات فول الصويا في المعمل والحقل باستخدام تكنيك غمر القطاعات النباتية في المعمل والرش المباشر في الحقل وتم تقيم التأثيرات الجانبية للجرعات لهذه المركبات على بعض الصفات البيولوجية للأكاروسين محل الدراسة معمليا. وقد اظهرت النتائج أن المبيد الاكاروسى ابامكتن كان الأكثر سمية يتبعه مركب الاثيون . وكان للزيوت النباتية زيت الثوم وزيت الزنزلخت تأثيرات منخفضة علي البيض للأكاروسين والأطوار المتحركة في المعمل والحقل. وأوضحت الدراسة العلاقة بين تأثيرات السمية والاختلاف البيولوجي لكل من الأكاروسين في المعمل والحقل حيث ظهرت فروق معنوية في التأثير السام والدراسات البيولوجية لكل من للأكاروسين محل الدراسة.