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Comparison between Toxicological and Biological Efficiency of some Aromatic Oils and other Compounds on Two Spotted Spider Mite

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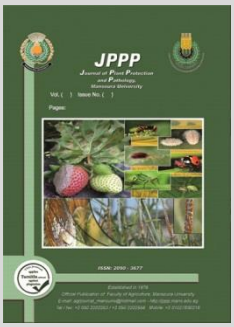

ABSTRACT

Control of the two spotted spider mite, *Tetranychus urticae*(Koch) using the conventional acaricides resulted in many problems . So, this study was carried out to evaluate the toxicity of certain alternative pesticides against this pest ,*T. urticae* as well as some biological aspects under laboratory conditions using two aromatic oils (Basil and Carnation) .one natural oil (Nat-1) and one conventional acaricide (Helbstar). The results indicated that Helbstar was the highest toxic compound to adult females of *T. urticae* followed by Nat-1 with Lc50 values of 1686.5 and 2861.5 ppm, respectively while Basil was the least toxic one with Lc50 value of 5990.4 ppm . The population showed more homogeneity in its response to the aromatic oils (Basil and carnation). Also, the results showed that the Helbstar caused the highest reduction in egg deposition with a mean number of 1.0 egg / day followed by Nat-1 with a mean number of 4.45 eggs / day , while Carnation was the lowest one with a mean number of 11.85 egg / day. The egg hatchability decreased with the increase of egg age at treatment by Basil , while in treating 1,2 and 3 day old eggs , the highest reduction in hatchability was found for Nat-1 , Helbstar and Carnation, with 100% reduction in hatchability at the three ages .Thus, the obtained results are of a great importance as they are taken into account in planning programs of integrated pest management.

Keywords: *Tetranychus urticae* , Toxicity and Biology , aromatic oils , pesticides

INTRODUCTION

The two spotted spider mite, *Tetranychus urticae* (Koch) is one of major economic pests in Egypt attacking several field crops, vegetables, fruits and ornamental plants. The infestation by mite dose not only cause direct damage to the plants by feeding on the plant juice but also due to indirect damage by transmitting various pathogens, such as virus, bacteria and fungi. The wide spread and extensive use of the conventional pesticides against agricultural pests caused several problems, development of pest resistance against pesticides and environmental pollution (Abd El Mageed 2002 and Saied and Soultan 2008) . Alternative non chemical methods of control have been widely assessed to solve partly these problems, and non conventional pesticides might be successfully used. Among of which are mineral oils, vegetative oils, microbial bio-agents, detergents and plant extracts (El Sisi and El Hariry, 1989, Schmuttere, 1997 and Hosny *et al*, 2003 a & b). Since different plant essential oils like sandal wood, cumin, clove, spearmint and lippiasidoides essential oil have been found to be active against *T. urticae* worldwide (Cavalcanti *et al*, 2010 and Kheradmand *et al* 2015).

Therefore, the present study was carried out to evaluate the toxicity of certain alternative pesticides against the spider mite , *Tetranychus urticae* (Koch) as well as some biological aspects under laboratory conditions.

MATERIALS AND METHODS

Three alternative pesticides were used; two aromatic oils (Basil and Carnation), one natural oil (Nat-1) and one conventional acaricide (Helbstar) were evaluated against spider mite , *T. urticae* under laboratory conditions .

1.Alternetive compounds :

Basil (*Ocimum basilicum*L.) 62% absolute oil , (parts used , Herb) . It was supplied by Hashem Brothers Company of Essential Oils and Aromatic Products, Giza , Egypt .

Carnation (*Diamthus caryophylceae*) 22% absolute oil (parts used flowers). It was supplied by Hashem Brothers Company of Essential Oils and Aromatic Products , Giza , Egypt .

Nat-1 (Jojoba oil , 96% Ec). It was supplied by Acarology Research Department, Plant Protection Research Institute, Giza , Egypt .

2. The conventional acaricide:

Pyridaben (Helbstar 20% EC) was supplied by Helb Company of Pesticides and Chemicals, Egypt.

3. Laboratory tests:

Toxicity of tested compounds to adult females of spider mite, *T. urticae*.

The strain of *T. urticae* was reared under laboratory conditions (25± 2ºc and 65± 5% RH) on sweet potato leaves away from any contamination with pesticides.

The susceptibility of adult females of *T. urticae* to the abovementioned compounds was evaluated using leaf disc dip method (Siegler 1947). Four discs of sweet potato leaves were dipped in each concentration for 5 seconds and left to dry. These used concentrations (Lc_{50}) were 1686.5, 2861.5, 4340.5, 5990.4 for Helbstar, Nat-1, Carnation and Basil. Then, 10 adult female mites were transferred to each disc. The discs were placed on moist filter paper which rested on moist cotton wool pad confind in petri-dishes and kept in the same condition of breeding room. Morality percentage was recorded 24 hours after treatment for compounds, Helbstar and Nat-1,and seven days after treatments of Basil and carnation. Correction for control mortality was made by using Abbott's formula (1925) . The toxicity curves were drawn and statistically analyzed according to Finney (1971) .

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Effect of Lc50 values of tested compounds on egg laying:

A similar technique was used to assay the residual effect of the tested compounds at Lc50 level to *T. urticae* eggs laying . Ten adult mite females were placed on each disc after treatment with Lc50 of each compound to after treatment, zero time.

Accumulative number of eggs laid was assessed 24, 48, 72, 96 and 120 hours later. All residue tests were conducted at 25± 2ºc and 65± 5% RH. Each treatment was replicated four times .Duncan's multiple range test (1955) at 5% level was used to reveal the significance among the numbers of egg laying of different treatments .

Effect of Lc50 values of tested compounds on hatchability:

Five adult females of *T. urticae* were transferred to potato leaf discs on wet cotton pad in petri-dishes to lay eggs for 24 hours, then removed. Each treatment involved number eggs at age of 1 day, 2 day and 3 day old in addition to control with the number of lay eggs. All treatments were dipped in Lc50 concentration of each compound for five seconds as well as in water as control. The hatchability was assessed five days after treatment and reduction in hatchability was counted for each tested compound.

RESULTS AND DISCUSSION

1- Toxicity of tested compounds against adult females of *T. urticae*.

The data in Table (1) indicated that Helbstar was the highest toxic compound to adult females of *T. urticae* followed by Nat-1 with Lc50 values of 1686.5 and 2861.5 ppm, respectively, while Basil was the least toxic one. These results are in agreement with those of Hosny *et al* (2003 a & b), who found that mineral oils came in the second category after specific acaricides in their toxicity to *T. urticae* under laboratory conditions. Also, data in Table (1) showed that Carnation displayed the highest slope (5.58) over all compounds , followed by Basil with a slope value of 3.64 , while Nat-1 displayed the lowest one (1.66) .

It is known as reported by Magouz(1997) that the slope value of log concentration probit line is considered as a reaction indicator between the chemical and affected organism . In other words, the highest slope value means more homogeneity in response of the organism towards the pesticide and in the same time the pesticide is acting as a selection factor producing an organism strain as pure genetically as possible , while the low slope value indicate heterogenous mite population , in its response to the chemical. Hoskims and Gordon (1956) postulated the fact that one of the first sign in the development of a resistant strain is the decrease in the slope of the dosage mortality line , therefore one expect that compound with low slope value may lead to development of resistance if used successively .

Concerning the toxicity index at Lc50 and Lc90 levels, the data in Table (1) confirmed that Helbstar was the most toxic compound to adult females of *T. urticae* with a toxicity index of 100 to both Lc50 and Lc90 followed by Nat-1 with a toxicity index of 58.94 at Lc50 and 77-46 at Lc90 of Carnation . Basil and carnation were the poorest toxic compounds to adult females with toxicity index of 28-15 and 38.86, respectively at Lc50 levels while Nat-1 and Basil were the poorest toxic compounds with toxicity index of 33-81 and 42-36, respectively at L90 levels.

The obtained results are in agreement with the results of Park *et al* (1996) who found that the acaricide abamectin solution killed all *T. urticae* females 24 hours after dipping. Also, Magouz (2003) found that abamectin was more toxic to adult females of *T. urticae* than the other tested compounds.

Table 1. Toxicity of certain compounds to adult females of *Tetranychus urticae* (Koch)

Compound	LC50 PPm	Confidence limits (c.L) lower	Confidence limits (c.L) upper	Slope value	Toxicity index of Lc50	LC90 PPm	Confidence limits (c.L) lower	Confidence limits (c.L) upper	Toxicity index of Lc90
Basil	5990.4	5498.02	6540.5	3.64	28.15	13464.60	11511.19	16811.24	42.36
Carnation	4340.5	4087.13	4609.6	5.58	38.86	7363.54	6792.9	7982.03	77.46
Helbstar	1686.5	1319.63	2155.33	2.42	100	5703.97	3835.89	8481.08	100
Nat-1	2861.5	2357.0	3427.0	1.66	58.94	16890.54	11620.79	30692.81	33.81

2- Accumulative eggs deposited by adult females mites of *T. urticae* on tested compounds zero time pretreated leaf discs during 5 days.

The data in Table (2) indicate the accumulative eggs deposited by adult females of *T. urticae* on different compounds pretreated leaf discs at zero time during 5 days. The data showed that Helbstar caused the highest reduction in egg deposition comparable to the control treatment through the first day while Basil, Carnation and Nat-1 indicated about the same effect on egg deposition of adult female mites.

The accumulative eggs deposited by adult females mite *T. urticae* from the second to the fifth day exhibited about the same trend to the first day. In general, the effect of tested compounds can be arranged descendingly as follows :Helbstar> Nat-1> Basil >Carnation > Control .

Table 2. A ccumulative eggs deposited by adult females mite *T. urticae* on different compounds zero time pre-treated leaf discs during 5 days .

Compound	No. of eggs deposited 1st day	2nd day	3rd day	4th day	5th day	Mean no. of eggs deposited/day
Basil	12.5[b]	30.0[c]	50.5[c]	51.5[c]	51.5[c]	10.30[c]
Carnation	14.5[b]	38.25[b]	57.75[b]	59.25[b]	59.25[b]	11.85[b]
Helbstar	3.25[c]	5.0[e]	5.0[e]	5.0[e]	5.0[e]	1.00[e]
Nat-1	12.0[b]	18.0[d]	21.5[d]	22.0[d]	22.25[d]	4.45[d]
Control	28.75[a]	52.0[a]	86.75[a]	101.75[a]	101.75[a]	20.35[a]

3- Effect of Lc50 values of the tested compounds on hatchability of *T. urticae* eggs.

Effect of Lc50 values of the tested compounds on hatchability of *T. urticae* eggs at three days (1,2and 3 days old) is indicated in Table(3) . It is apparent that egg hatchability decreased with the increase of egg age at treatment by Basil.

At treatment of 1 day old eggs, Nat-1 and Helbstar were the most effective compounds on eggs hatching, followed by Carnation, while Basil was the least effective one. At treatment of 2 day old and 3 day old eggs , the highest reduction in hatching eggs was found for Carnation and Nat-1 (100% reduction) of two compounds through two

egg ages followed by Helbstar which occupied second rank being 98 .74% and 100 % reduction in 2 day old egg and 3 day old egg , respectively . Basil was the least effective one with 60.70 and 87.31% reduction for two egg ages , respectively . In other words , Nat-1 and Helbstar were a good ovicide relatively compared to the other tested compounds . In general, the effect of different compounds on hatching can be arranged descendingly as follows :

Nat-1> Helbstar>Carnation > Basil >Control . The obtained results agree with those of Magouz and Khattab (2014) , who found that the egg hatchability of spider mite is influenced by egg age at treatment by median lethal concentration of Nat-1 was most effective than other tested compounds through two egg ages .

Table 3. Effect of LC50 values of the tested compounds on hatchability of *Tetranychus urticae* eggs at the three ages.

Compound	Lc50 (ppm)	Egg age (in days)					
		1day old		2day old		3day old	
		%H	%Reduction	%H	%Reduction	%H	%Reduction
Basil	5990.4	31.04	68.97	39.31	60.70	12.70	87.31
Carnation	4340.5	3.28	96.73	0.0	100	0.0	100
Helbstar	1686.5	0.0	100	1.27	98.74	0.0	100
Nat-1	2861.5	0.0	100	0.0	100	0.0	100
Control	-	81.82	18.19	81.18	18.83	88.24	11.77

%H = % Hatchability

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مقارنة بين تأثيرات السمية والبيولوجية لبعض الزيوت العطرية والمركبات الأخرى على العنكبوت الأحمر ذو البقعتين

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معهد بحوث وقاية النباتات – محطة البحوث الزراعية – سخا – محافظة كفر الشيخ

لقد أدى استخدام المبيدات الأكاروسيه التقليدية في مكافحة العنكبوت الأحمر ذو البقعتين ، تترانيكس بورتيكا إلى حدوث مشاكل كثيرة ، لذا أجريت هذه الدراسة لتقييم سمية بعض بدائل المبيدات ضد هذه الأفه إضافة إلى تأثيرها على بعض المظاهر البيولوجية تحت الظروف المعملية .وقد استخدم في هذه الدراسة مركبان من الزيوت العطرية (هما الريحان والقرنفل) ومركب من الزيوت الطبيعية (نات - 1) ومركب أكاروسى (هلب ستار) . وقد أوضحت نتائج هذه الدراسة أن مركب الهلب ستار كان أعلى المركبات سمية ضد الإناث البالغة للعنكبوت الأحمر، يليه الزيت الطبيعي نات – 1 بقيمة Lc50 (1686.5 ، 2861.5 جزء في المليون) على التوالي ، بينما كان مركب الريحان أقلهما سمية بقيمة Lc50 (5990.4 جزء في المليون) . كما أوضحت النتائج أن مركب الهلب ستار أعطى أعلى معدل خفض في عدد البيض الموضوع للأناث البالغة بمتوسط عدد بيضة واحدة / اليوم ، يليه مركب نات– 1 بمتوسط 4.45 بيضة / اليوم بينما كان القرنفل أقل المركبات تأثيرا حيث كان متوسط عدد البيض 11.85 بيضة / اليوم . كما أوضحت النتائج أيضا أن نسبة فقس البيض الموضوع قد انخفض بزيادة عمر البيض الموضوع في المعاملة بمركب الريحان ، كما وجد أن معاملة البيض الموضوع عمر 1 ، 2 ، 3 يوم بمركبات نات – 1 ، وهلب ستار ، القرنفل قد سجلت نسبة خفض في فقس البيض بلغت 100% خلال الأعمار الثلاثة المذكورة وهكذا فإن النتائج المتحصل عليها لها أهمية كبيرة حيث تؤخذ في الاعتبار عند تصميم برامج الإدارة المتكاملة للآفات.