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Effectiveness of plant extracts and traditional compounds against *Tetranychus urticae* Koch, under field conditions in Squash

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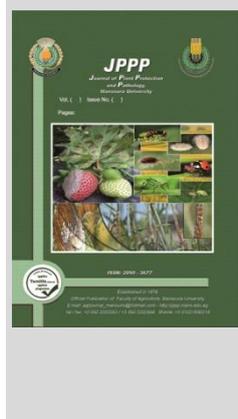


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ABSTRACT

Find alternative compounds to control two spotted red spider mite, *Tetranychus urticae* Koch, in Squash is very important to protect squash and to avoid the problems could be occurred due to the extensive usage of conventional acaricides. The plant extracts camphor, menthol, thymol and citric acid efficiency against *T. urticae* was tested under field condition in comparing with acetamiprid and *azadirachta indica* (Neem). The results revealed that during 2018 winter season there were significant differences as a primary effect in between the tested compounds, where the highest reduction rate among the plant extracts tested after one day of treatment was recorded with citric acid 88.5%. The tested compounds also showed good efficiency after three, five and seven days of treatment as a residual effect. There were no significant differences found between the tested compounds and the standard compounds. The highest reduction rates were recorded for azadirachtin and acetamiprid 93.87%, 90 %., respectively. Whereas, in case of the tested plant extracts, the highest reduction rates were observed for the camphor 88.97 % followed by menthol 88.13%. The results also indicated that during the summer season 2019 significant differences after one day of spraying as initial effect of the tested compounds were detected. The highest rates of reduction were as follow: 89.51, 85.70, 82.63 and 81.25% for citric acid, menthol, thymol and camphor compared to 95.97 and 93 .84% reduction achieved by azadirachtin and acetamiprid as standard treatments respectively.

Keywords: mites, Squash, camphor, menthol, acaricides



INTRODUCTION

Two spotted red spider mite, *Tetranychus urticae* Koch, (Tetranychidae: Prostigmata) is a series pest of several vegetables such as squash, tomatoes, eggplants and cucumber (Fasulo and Denmark 2000). It can infect flowers, leaves, and stems causing destructive effect. Due to the cuticle-layer is very thin, the lower leaf surface of the plants is preferred for *T. urticae* infestations (Abo-Bakr and Ali 2005 and Abdallah et al 2018). Moreover, it is able to transmit many of plants viruses (Thomas 1969). Crops must be protected with synthetic acaricides during hot and dry seasons that favor severe outbreaks of *T. urticae*. Conventional acaricides used against *T. urticae* extensively caused serious adverse effect on human health and resulted in development of resistant populations which complicated the control process (Beers et al., 2005; Toyoshima, 2003). Choi *et al* (2004) reported that several plant extracts effectively used against different species of spider mites. Bakr (2013) tested the fumigant effect of camphor against *T. urticae* Koch and the results proved that camphor showed reasonable toxicity which increased by increasing temperature. Modarres-Najafabadi (2012) tested the effect of thyme (*Thymus vulgaris*) against two spotted spider mite (TSSM), *T. urticae* Koch with five different concentrations (0.5%, 1%, 2%, 3% and 4%) and they reported that the LC₅₀ value for adult mites was 1.84 ppm. Moreover, Mina et al (2015) tested the contact toxicity of a mixture of menthol 5%, thymol 5% against eggs and female adults of *T. urticae* and they found that LC₅₀ value for menthol 5% + thymol 5% was (656.77µl/l) 24 hours after the treatment.

While, the mixture was highly effective against eggs with LC₅₀ value (967.24 µl/l). So, the main purpose of this study was to examine the efficiency of five plants extracts namely citric acid, thymol, camphor, menthol and azadirachtin in addition acetamiprid (neonicotonioid) against *T. urticae* under field conditions.

MATERIALS AND METHODS

1- The plant extracts and insecticides used:

Cinnamomum camphor (Or. Laurales: F. Lauraceae), Peppermint, *Mentha piprria* (Or. Lamiales: F. Lamiaceae), thyme, *Thymus vulgaris* (Or. Lamiales F. Lamiaceae) and Citric acid in addition to traditional compounds, (Acetamiprid and Azadirachtine *neem* based formulation) against red spot spider, *Tetranychus urticae* C. L. Koch, 1836 (Or. Trombidiformes: F. *Tetranychidae*) clarified in (Table 1).

Table 1. The plant extracts and insecticides used in the experiments against *T. urticae*.

Tested compounds	Usage rate
Citric acid	1% -1.5%-2%
Thymol	1% -1.5%-2%
Camphor	1% -1.5%-2%
Menthol	1% -1.5%-2%
<i>Azadirachta indica</i> (Neem)	50 ml / 100 L Water
Acetamiprid	25 g / 100 L water

2- Field experiments:

The experiment was carried out the Al-Bustan basin, Kafr Ghannam Village - Sinbillawain – Dakahlia, Governorate, during 2018-2019 seasons. Plots were prepared in the 2nd week of Nov. 2018 and middle of May

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2019. *Zucchini (disambiguation)* (Or. Cucurbitales : Fam. Cucurbitaceae) *Cucurbita pepo* L. The cultivated squash variety was USAS21003 trade name Hybird Fadw In 2018 winter season. While in 2019 summer season the Squash variety, USASR 80005, FARAH. In all agricultural operations such as irrigation and fertilization were carried out according to the recommendations of the Ministry of Agriculture in the two seasons.

The experimental plots have an area of 525 m², divided into six-pieces, in addition to a piece that has left a comparison and each treatment has an area of 60m², leaving breaks between the transactions. Transactions were examined and upon the arrival of the two spotted spider mite from 5-8 nymphs insects/leaf in 2-inch, spraying was done with previously equipped products using the machine with a capacity of five liters of water. The reduction percentage was calculated after three, five and seven days spraying post treatment, using the equation of Henderson and Tilton (1955).

3- Statistical analysis:

Data was analyzed by the variance (ANOVA), means of treatments compared with LSD_{0.05} test in SAS program (SAS Institute 1988). The reduction% was calculated according to equation Henderson and Tilton (1955).

RESULTS AND DISCUSSION

1. The effect of tested compounds against the two-spotted spider-mites *Tetranychus urticae* Koch, during winter season 2018 on Squash plants:

The results in Table (2) indicated that there were no significant differences between the red spider populations before spraying the tested compounds during 2018 winter season. While one day after the application of the tested compounds, the results showed that there was statistically significant differences detected as a primary effect of the tested compounds, citric acid gives the gives the highest reduction rate 88.5% after one day of treatment .

Table 2. Effectiveness of tested compounds against two-spotted spider-mites *T. urticae*, infected Squash plants during winter 2018 season.

Treatments	Conc. % wt/v	Mean of Infestation before Treatment (No/leaf)	Initial effect after one day		Residual effect					General effect %R
			Mean No/leaf	%R	No / leaf /day after			Mean No/leaf after 3, 5,7 days	%R after 3, 5,7 days	
					3	5	7			
Citric acid	1	4.80	1.20	84.6	2.20	1.00	0.90	1.36	85.80	85.20
	1.5	5.00	0.80	90.1	1.60	0.90	0.90	1.13	88.70	89.40
	2	4.70	0.70	90.8	1.20	0.80	0.90	0.96	89.70	90.25
Average		4.83	0.90	88.50 abc	1.67	0.9 a	0.9 a	1.15 a	88.07	88.28
Thymol	1	4.8 0	1.80	76.9	2.00	1.00	1.00	1.30	86.40	81.65
	1.5	4.50	1.20	83.5	1.5	0.90	0.80	1.06	88.20	85.85
	2	4.30	0.80	88.5	1.10	1.00	0.80	0.96	88.80	88.65
Average		4.4	1.27	82.96 c	1.53	0.97 a	0.87 a	1.17 a	87.80	85.38
Menthol	1	4.50	1.50	79.4	2.10	0.80	0.90	1.26	86.00	82.70
	1.5	5.00	1.20	85.2	1.60	1.10	0.80	1.16	88.40	86.8
	2	5.20	0.80	90.5	1.20	1.00	0.90	1.03	90.00	90.25
Average		4.9	1.17	85.03bc	1.63	0.97 a	0.87 a	1.15 a	88.13	86.583
Camphor	1	3.90	1.60	74.7	1.20	1.00	0.80	1.00	87.00	80.85
	1.5	4.60	0.50	79.9	1.10	1.00	0.90	1.00	89.10	84.50
	2	4.90	0.80	89.9	1.00	0.90	0.80	0.90	90.80	90.35
Average		4.47	0.97	81.5 c	1.1	0.97 b	0.83 a	0.97 a	88.97	85.23
Acetamiprid		5.00	0.60	92.6 a b	1.20	1.00 a	0.8 b	1.00 a	90.00	91.30
Azadirachtin		4.90	0.40	94.97 a	0.90	0.50 b	0.40 b	0.60 b	93.87	94.42
F		NS	NS	*	NS	*	*	**	NS	NS
LSD _{0.05}				0.21		0.26	0.32	0.26		

Within the same column and source data followed by the same letter are not significantly. Different (P>0.05; LSD mean separately.

Moreover, the compounds tested after treatment with three, five and seven days as a residual effect and the results revealed that there were no significant differences found between the tested compounds and the standard compounds, and the highest reduction rates were recorded for azadirachtin and acetamiprid 93.87%, 90 %, respectively. Whereas, in case of the tested plant extracts, the highest reduction rate was observed for the camphor 88.97 % followed by 88.13% for menthol then 88.07 and 87.80 % with citric acid and thymol as compared with the standard compounds 93.87 and 90.% of each azadirachtin and acetamiprid, respectively. Results cleared that the general reduction rates can be arranged as follows: citric acid, menthol, thymol and Camphor 88.28, 86.58, 85.38 and 85.23%. as compared with the standard compounds 94.42 and 91.30 % for both azadirachtin and acetamiprid. In

general, we conclude that, the best tested plant extracts are citric acid, followed by menthol 88.28 and 86.58%.

2. The effect of tested compounds against the two-spotted spider-mites *Tetranychus urticae* Koch, during summer season 2019 on Squash plants:

The results in Table (3) showed that the treatment of squash plants with certain plant extracts during the summer season 2019 against the red spider mite revealed that there were non-significant differences between the compounds tested before spraying at different concentrations. The results also indicated the presence of significant differences after the day of spraying as initial effect of the tested compounds where the highest rate of reduction were as follow: 89.51, 85.70, 82.63 and 81.25% for each of the citric acid, menthol, thymol and then camphor after a day of treatment compared to 95.97 and 93 .84% reduction in the

number of pest at azadirachtin and acetamiprid as standard treatments. The results recorded non-significant differences ranged between the tested extracts at different concentrations as a residual effect after three, five and seven days of treatments. All of tested compound caused high reduction effect for the mite's population for all treatments, and it were as follows: 89.54, 89.36, 89.00 and 88.04% for menthol, camphor, citric acid and thymol compared to 94.37 and 90.69% for standard compounds azadirachtin and

acetamiprid. According to the results obtained in the current study, the general effect of the compounds tested against the red spider mite population can be arranged according to the reduction percentages as follows: 89.25, 87.60, 85.32 and 73.31% for citric acid, menthol, thymol and camphor, compared to 95.17 and 92.26% Acetamiprid and Azadirachtin.

Table 3. Effectiveness of tested compounds against two-spotted spider-mites *T. urticae*, infected Squash plants during summer 2019 season.

Treatments	Conc. % wt/v	Mean of infestation before treatment (No/leaf)	Initial effect after one day		Residual effect			General effect %R		
			Mean No/leaf	%R	No / leaf /day after					
					3	5	7			
Citric acid	1	4.60	1.10	85.57	1.90	0.90	0.80	1.20	86.78	86.17
	1.5	4.80	0.70	91.20	1.04	0.80	0.80	1.00	89.44	90.32
	2	4.40	0.60	91.77	10.10	0.70	0.60	0.80	90.78	91.27
Average		4.6	0.80	89.51 abc	4.35	0.8	0.73 a	1.00	89.00	89.25
Thymol	1	4.40	1.80	75.32	1.90	0.70	0.70	1.10	87.33	81.32
	1.5	4.40	1.10	84.65	1.5	0.80	0.70	1.00	88.20	86.38
	2	4.00	0.80	87.93	1.20	0.80	0.70	0.90	88.60	88.26
Average		4.27	1.23	82.63 c	1.533	0.76	0.7 a	1.00	88.043	85.32
Menthol	1	4.30	1.40	80.36	1.80	0.70	0.80	1.10	87.03	83.69
	1.5	4.50	1.00	86.59	1.40	0.60	0.70	0.90	89.86	88.22
	2	4.90	0.80	90.15	0.90	0.80	0.7	0.80	91.72	90.93
Average		4.57	1.07	85.7 b c	1.37	0.7	0.73 a	0.93	89.54	87.6
Camphor	1	4.20	1.80	74.14	1.30	0.90	0.80	1.00	87.93	81.03
	1.5	4.50	1.50	79.89	1.10	0.90	0.70	0.90	89.86	48.88
	2	4.70	0.80	89.73	1.00	0.90	0.80	0.90	90.29	90.01
Average		4.47	1.37	81.25 c	1.13	0.9	0.77 a	0.93	89.36	73.31
Acetamiprid		4.90	0.50	93.84 a b	1.00	0.90	0.80 a	0.90	90.69	92.26
Azadirachtin		4.50	0.30	95.97 a	0.80	0.40	0.30 b	0.50	94.37	95.17
F		N S	N S	*	N S	N S	**	N S	N S	N S
LSD _{0.05}				9.16			0.19			

Where: Wt/v= wait/volume. Within the same column and source data followed by the same letter are not significantly different (P>0.05); LSD mean separately.

The plant extract could be used as alternative tool to protect the squash plant and other vegetables from *T. urticae* infestation many authors reported such kind of results. Dahroug *et al.* (2000) reported that camphor-olive oil mixture showed high acaricidal activities against females of *T. urticae* in lima bean field, (*Phaseolus vulgaris*). Infestation was highly reduced mites after 24 h of treatment. Also, the population densities of *T. urticae* were significantly reduced at one day after spraying. Moreover, the efficiency of two volatile plant oils, camphor and citronella against *T. urticae* infesting aubergine showed successfully controlled mite. In the same way EL-Zemity *et al.* (2009) evaluated certain plant extracts as Chenopodium, caraway, cinnamon, clove, eucalyptus, fennel, Geranium, garlic, lemon, matercary, peppermint [Menthapiperita], rosemary and thyme [Thymus]) essential oils and fourteen of their major monoterpenoids (benzyl alcohol, borneol, camphor, carvone-(S), carvone-(R), carvacrol, carveol, citronelol, cineole, cinnam aldehyde, chlorothymol, geraniol, menthol and thymol) against *T. urticae*. The plant extracts assays after 24 h were highly potent against *T. urticae* followed by thymol, carvacrol and cinnam aldehyde. Wu *et al.* (2017) tested essential oils thyme against carmine spider squashes (*T. cinnabarinus*). Natural thyme oil showed greater toxicity than any single constituent or blend of constituents. Also showed that thymol was the most

abundant component, and strongest acaricidal activity compared with other single constituents.

CONCLUSION

Due to problems occurred as a result of the extensive usage of traditional acaricides to control *T. urticae* there was a real need to find new alternative methods. The plant extracts Camphor, Menthol, Thymol and Citric acid showed high efficiency in comparing with acetamiprid and *azadirachta indica*.

(Neem). In the winter 2018 season, the citric acid resulted highest reduction percentage 90.25%, in the same trend, citric acid resulted highest reduction percentage 91.27% in summer 2019 season.

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كفاءة بعض المستخلصات النباتية والمبيدات التقليدية فى مكافحة العنكبوت الاحمر فى الكوسة تحت ظروف الحقل

محمد انور السيد ، ليلي رجب الجوهري ، عادل عبدالمنعم صالح و على على عبدالهادى سعيد

قسم المبيدات - كلية الزراعة - جامعة المنصورة

الملخص

البحث عن طرق بديله لمكافحة العنكبوت الاحمر والذى يصيب محصول الكوسة فى غاية الاهمية وذلك لحماية المحصول وتجنب المشاكل التي قد تتجم عن الاستخدام المكثف للمبيدات التقليدية . اختبار كفاءة المستخلصات النباتية مثل الكامفور و المينثول و الثايمول و الستريك اسيد تحت ظروف الحقل بالمقارنة بالاستيميريد و الازاديركتين. توصلت الدراسة الى النتائج الاتيه خلال موسم شتاء 2018 لم يتم رصد اى فروق معنويه فى نسب الخفض بين المستخلصات النباتية المختبره بعد يوم واحد من الرش بينما بعد المعاملة ب 3 و 7 ايام من الرش حيث سجلت اكثر الانخفاضات فى تعداد الافه بعد استعمال الازاديركتين و الاستيميريد 93.87 و 90% على التوالي بينما كانت اكثر المستخلصات النباتية كفاءه هى الكامفور و المينثول بنسب خفض 88.97 و 88.13% على التوالي . كما اشارت النتائج المتحصل عليها بعد اجراء التجارب فى موسم الصيف لعام 2019 انه لوحظ اختلاف فى نسب الخفض فى تعداد العنكبوت الاحمر كانت على النحو التالى 98.51 و 85.70 و 82.63 و 81.25% الستريك اسيد ثم المينثول ثم الثايمول ثم الكامفور على التوالي بعد يوم واحد من المعاملة بالمقارنة بالاستيميريد 93.84% و الازاديركتين 95.97% .