EFFICACY OF CERTAIN PLANT EXTRACTS ON THE BIOMETRICS OF THE TWO-SPOTTED SPIDER MITE, *TETRANYCHUS URTICAE* (KOCH).

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ABSTRACT

The present study evaluated the residual effects of two plant extracts (black cumin and wormseed) on the two-spotted spider mite, *Tetranychus urticae* (Koch). The results indicated that black cumin was more toxic than wormseed to adult females of *T. urticae* with LC_{50} (887 and 1861.3 ppm.) respectively. The obtained results concluded that the black cumin and wormseed (plant extracts) proved to be more toxic to older eggs than to younger ones with LC_{50} values of 6744, 8027, 5051, 6011, 3219 and 4949.91 ppm. respectively for the 1-day, 2-days and 3-days old eggs of *T. urticae*.

Black cumin and wormseed highly reduced the number of eggs deposited compared to the control treatment. Black cumin had a moderate effect on egg hatchability, while wormseed extract was the least effective one. Black cumin also, had a moderate effect on sterility followed by wormseed. The tested plant extracts had the ability to elongate the duration needed for all immature stages and life cycle, while they were able to decrease oviposition period and the adult female longevity.

INTRODUCTION

Phytophagus mites are major pests of the main food crops and their potential for damage has become increasingly evident during the last few decades (Amano and Chaat, 1977). A wide range of chemicals have been marked for controlling the two-spotted spider mite. The wide use of the chemical compounds has resulted in many problems such as population

outbreaks and chemical resistance, endangering human health and wealth. Therefore the world decided to reduce chemicals use and tried to introduce predators and biocontrol agents such as virus, bacteria and fungi in an I.P.M. Programs.

Controlling phytophagous mites by a combination of biological and chemical methods proved to be less costly and more permanent method of control than the pesticides alone (Hislop and Prokopy, 1981). Sublethal effects can supplement mortality in several ways, for example, by causing the organism to avoid treated surfaces, by reducing the reproductive potential (Jackson and Wilkins, 1985), and by interfering with feeding and oviposition (Hajjar and Ford, 1989). Iskander *et al.* (1996) reported that plant extracts affected eggs, adult females and biological aspects of *Tetrancychus arabicus* Attiah, Nassef (1998), reported that black cumin had a considerable toxicity to *T. urticae.*

Gamieh and Saadoon (1998) evaluated the influence of sublethal concentrations (LC_{25}) of the tested acaricides (Neron, Sanmie, Ortus, Vertemic and Biomite) on some biological aspects of *T. cucurbitacearum.* All the compounds had the ability to elongate the pre-oviposition period, while they were able to decrease the adult female longevity oviposition and post oviposition periods. Egg viability and female fecundity were adversely affected by all of the compounds, however, vertimec was more harmful compared to the other compounds in this respect. Hosny *et al.* (1998) found that the pyrethroids fenvalerate and deltamethrin were highly effective in decreasing spider mite fecundity.

Mousa and El-Sisi (2001) indicated that cotton seed oil EC was effective for its initial and residual effect against *T. urticae* eggs and mobile stages on Squash crop.

Castiglioni *et al.* (2002) showed that neem seeds and neem oil extract (1 and 2% v/v) were toxic to *T. urticae.* Also, Farage and Zakgouk (2002) found that moderate effect was noticed with Jojopoa oil against *T. urticae.*

Abd El-Wahab (2003) indicated that castor oil treatment appeared to be the most effective against the population of *T. urticae* than soybean seed oil on cucumber.

Clearly, if chemical, microbial pesticides and biological methods are successfully integrated, then the impact of pesticides used to control key pests and diseases must be minimized while the beneficial arthropods must be introduced .

The present study was carried out to evaluate the toxic effects of two plant extracts (black cumin and wormseed) against the egg stage and adult females and the side effects of sublethal doses of tested compounds on some biological aspects of the two spotted spider mite *T. urticae*.

MATERIALS AND METHODS

1. prey cultures :

The stock culture of the two spotted spider mite, *Tetranychus urticae* (koch) (Acarina; Tetranychidae) was collected from castor bean plants, Kafr El-Sheikh Governorate and reared under laboratory conditions according to Dittrich (1962). The mite culture were kept at 25±2°C under 16 hours photoperiod to encourage plant growth and 65±5 R.H..

2. Chemicals used :

* Two plant extracts (black cumin and wormseed).

Scientific name	Common name	Parts used
- *Nigella sativum* linn	Black cumin	Seeds
Fam : Ranunculacae.		
- *Artenisia cinae* L.	Wormseed	Leaves
Fam : Compositae.		

The plant sample (wormseed) was thoroughly washed in detergent solution followed by rinsing in tap water, air dried at room temperature and in an oven at 40°C, then ground to fine powder. The powder was divided into batches each weighed 100gm, which was macerated in 300ml of acetone/methanol (1 :1 v/v) for 72 hours in a dark bottle. During the maceration period the sample was shaken for 6 hours using an electric shaker. The extract was filtered and placed in a refrigerator for 24 hours, the extract was then refiltered, dried over anhydrous sodium sulphate and evaporated to dryness using a rotary evaporator. The residue was considered as the active ingredient, weighted and dissolved

in acetone to form the required concentractions. An amount of 5 g black cumin seeds powder were extracted in 100ml of absolute ethanol (75%). The extraction was run over night then followed by filtration .

3. Experimental techniques:

3.1. Toxicity of the tested compounds to adult female mites, *T. urticae* and eggs:

The toxic effect of the tested compounds to adult female mites. *T. urticae* and eggs were evaluated by the leaf disc dip technique according to Siegler (1947). Each treatment was replicated four times, in the case of plant extracts 10 adult female mites were transferred to each disc, these discs were dipped in different concentrations of each plant extract. These discs were placed on moist filter paper which rested on moist cotton wool pad contained in petri dishes and kept under controlled conditions of 25±2°C and 65±5 R.H. Mortality counts were made 24 hours after treatment for adults. Correction for control mortality was made by using Abbortt's formula (1925). The data were statistically presented according to the method of Finney (1952). Eggs mortality was calculated as follows :

Egg mortality = (a/b) x 100

Where :

a = Unhatched eggs.

b = Total number of eggs which counted before dipping .

3.2. Effect of compound residues on egg deposition and egg-hatching of *T. urticae.*

The residual effect of each tested compound at LC_{25} level on adult spider mites was evaluated according to Keratum *et al.* (1994). The percent of sterility in mated females was calculated according to Toppozada *et al.* (1966).

$$\% \text{ sterility} = 100 \left[\frac{ab}{AB} \times 100 \right]$$

Where :

a = No. of eggs laid/female in treatment.
b = % of hatching in treatment.
A = No. of egg laid/female in control.
B = % of hatching in control.

3.3. Effect of compound residues on some biological aspects of *T. urticae:*

The residual effect of the tested compounds on some biological aspects of spider mites was examined using the method of Smith *et al.* (1963).

Young plants bearing only 4 primary leaves were dipped in the required concentration of compound. After the foliage had dried the plants were infested with 5 adult females on each plant. In the case of plant extracts, the plants were infested with 5 adult females on each plant, these plants were dipped in the required concentration of plant extract. After the mites had become established and had laid eggs for one day, adults of *T. urticae* were removed and the eggs mortality was recorded. The stages present were counted from treated and untreated till adult stages. Data were statistically analyzed according to Litchfield and Wilcoxon (1949).

RESULTS AND DISCUSSION

1. Toxicity of tested compounds to adult females of the two-spotted spider mites *T. urticae:*

The results (Table, 1) showed that the extract of black cumin was more toxic than wormseed extract with LC50 values of 887 and 1861.3p.p.m., respectively. Wormseed and black cumin have slope values of 1.67 and 1.25, respectively. It is known as reported by Hoskins and Gordon (1956) that the slope value of Log concentration-probit line is considered as a reaction indicator between the chemical and the affected organism.

Black cumin and wormseed extracts were toxic to the adult females of *T. urticae.* These results are in agreement with

findings of El-Halwany *et al.* (1988) who reported that cumin oil was more toxic to the adults stage of *T. urticae* than the other tested extracts. Iskander *et al.* (1996) found that shih extract had stronger activity to adult females of *T. arabicus*, Also Nassef (1998) found that the vegetative oil (black cumin) had a considerable toxicity to *T. urticae*.

Table (1). Toxicity of the two plant extracts to the adult females of the two-spotted spider mite, *T. urticae*.

Compounds	LC_{50} ppm	Slope value	Confidence limits
Black cumin	887	1.25	646-1253
Wormseed	1861.3	1.67	1277-2479

2. Toxicity of tested compounds on different egg stages of the two-spotted spider mite *T. urticae:*

The toxicity of the two plant extracts on one-day, 2 days and 3 days old-eggs of *T. urticae* are presented in Table (2). The data indicated that the black cumin and wormseed (plant-extracts) in a category of leaf effective compounds on all stages of eggs of spider mite with LC50 values of 6744, 8027 (1-day), 5051, 601(2-days), 3219 and 494.91 (3-days) p.p.m., respectively. Slope values of the log concentration probit lines, indicated that black cumin has the higher slope value (1.33, 1.31 and 1.49), than the wormseed (1.32, 1.18 and 1.16). The highest slope value means more homogenity in the response of egg population towards the tested compound. It could be concluded that the tested compounds proved to be more toxic to older eggs than to younger ones. The obtained results are in agreement with that recorded by (El-Monairy *et al.*, 1994; Abdel-Samed 1998 and Derbalah, 1999).

Table (2): toxicity of two plant extracts on different egg stages on the two-spotted spider mite *T. urticae*.

Compounds	1-day old eggs			2-days old eggs			3-days old eggs		
	LC_{50} ppm	Slope value	Conf. lim.	LC_{50} ppm	Slope value	Conf. lim.	LC_{50} ppm	Slope value	Conf. lim.
Black cumin	6744	1.33	5628-8200	5051	1.31	4179-6118	3219	1.49	2674-3822
Wormseed	8027	1.32	6493-10238	6011	1.18	4655-7931	4949	1.16	3996-6149

3. The effect of compounds residues on the biology of two-spotted spider mite *T. urticae:*

3.1. Egg deposition:

The effect of sublethal concentrations of tested compounds (LC_{25}) on eggs deposited by the adult females mites, *T. urticae* was studied. Ten adults female mites were allowed to oviposite on different compounds treated leaf discs for a period of 3 days. The deposited eggs were counted daily for three days the data in Table (3) indicated that plant extracts (black cumin and wormseed) caused high reduction in deposite eggs compared to the control treatment through the first day. Through the second day of oviposition, plant extracts (black cumin and wormseed) were still of the highest effect on the fecundity of mite comparable to the control treatment. Through the third day of egg deposition, black cumin was still of the highest effect on the fecundity of mite followed by wormseed and there are no significant differences between them. From the mean number of eggs deposited by one adult female of *T. urticae*/day on leaf disc treated by different compounds (table 3), results suggested that plant extracts were the most effective compounds on egg deposition.

Table (3): Effect of tested compound residues on egg deposition and egg hatchability of *T. urticae.*

Compounds	Egg deposition				Egg hatchability			
	Mean No. of egg depos. At first day	At second day	At third day	General mean	Mean No. of hatched eggs*			
					24 hrs.	48 hrs.	72 hrs.	General mean
Black cumin	4.00c	3.25 c	2.25 b	3.17 b	15.25b	1.00c	6.25 c	10.50b
Wormseed	5.50 b	4.25 b	2.75 b	4.17 b	17.00b	11.00b	7.25 b	11.75b
Control	12.00 a	10.25 a	7.00 a	9.75 a	19.75a	14.50a	9.75a	14.67a
L.S.D. 5%	1.19	0.80	1.00	2.28	3.87	2.12	0.80	15.24
1%	1.71	1.15	1.43	3.27	5.56	3.04	1.15	21.89

- **Mean No. taken for 10 adults.**

The obtained results were in agreement with those recorded by (Keratum, 1993, Ayyappath *et al.*, 1997 and Hosny *et al.*, 1998). Many investigators showed that the plant extracts had a positive effect on egg deposition of the spider mites.

Also, Amer *et al.* (1989) found that treatment of raspberry leaf discs with the LC_{50} and LC_{25} of the petroleum ether extract significantly decreased the number of eggs deposited by females of *T. urticae.* Dimetry *et al.* (1990) reported that spraying females with the LC_{25} for beta-amyrin caused a significant reduction in fecundity and the viability of resulting eggs.

In addition Dimetry *et al.* (1993) found that spider mites feeding on leaf discs treated with different concentrations of the two neem seed kernel extract of *Azadirachta indica* showed a significant reduction in the total number of eggs laid.

3.2. Egg hatchability :

Data in Table (3) indicted that through the three days it was apparent that, black cumin had a moderate effect on egg hatchability, while wormseed was the least effective compound on egg hatchability of *T. urticae.* The present results were in agreement with those of Hosny *et al.*, 1998 and Derbalah, 1999.

The data in Table (4) showed the comparative effect of the selected compounds (LC_{25}) on egg production of treated adult female mites during 3 days.

Table (4). Effect of tested compounds on reduction in egg laying and sterility in one emerging adult mated female of *T. urticae.*

Compounds	No. of egg/female during 3 days after treatment	% Reduction in no. of eggs/female	% hatching	% Sterility mated female
Black cumin	9.50	67.52	68.75	77.26
Wormseed	12.50	57.26	78.33	65.91
Control	29.25	-	98.18	-

Plant extracts (black cumin and wormseed) were the highest effective compounds on the total number of eggs laid than that laid by untreated females. The note of decrease was by 67.52% and 57.26% of black cumin and wormseed respectively.

From the previous results (Table 4) it is clear that, plant extracts (black cumin and wormseed) had a moderate effect on sterility where percent sterility in mated females were 77.26 and 65.91 for black cumin and wormseed respectively.

Many workers found similar results on mites (Dimetry *et al.* 1993; Nassar *et al.* 1995; Osman, 1997 and Gamieh and Saadoon, 1998).

4. Effect of certain plant extract with (LC_{25}) on the biological aspects of *T. urticae:*

The experiments were conducted under the controlled conditions of 25±2°C and 65±5 R.H.

The results in Table (5) showed that the black cumin and the wormseed significantly increased the duration of active larvae, the values were 3.13 and 2.75 days, respectively, compared with 1.38 days for the control. The quiescent larvae averaged 1.88 and 1.63 days for black cumin and wormseed treatment compared with an average of 1.13 days for the control. The duration of quiescent protonymph averaged 1.88 and 1.63 days for black cumin and wormseed treatments, compared with an average 1.25 days for the control. The duration of the active deutonymph was significantly increased for black cumin and wormseed treatment, 2.88 and 2.75 days

respectively, compared with 1.75 days for the control. The mean periods of the immature stages were 13.75 and 12.25 days for black cumin and wormseed respectively, compared with average of 8.50 days for the control (Table 5).

Table (5). Effect of two plant extracts (black cumin & wormseed). on the biological aspects of *T. urticae* after adult females treatment with LC_{25} level.

Development of stage	Black cumin		Wormseed		Control	LSD	
	Duration (in days)	Mortality (%)	Duration (in days)	Mortality (%)	duration (in days)	5%	1%
Incubation period	4.25±0.29		4.13±0.25		3.87±0.25	-	-
Active larvae	3.13±0.25a	23.08	2.75±0.29a	15.38	1.38±0.25b	0.42	0.61
Quiescent larvae	1.88±0.25a	15.38	1.63±0.48ab	7.69	1.13±0.25b	0.55	0.79
Active protonymph	2.13±0.25	7.69	1.75±0.29	0.00	1.63±0.25	-	-
Quiescent protonymph	1.88±0.25a	0.00	1.63±0.25ab	7.69	1.25±0.29b	0.42	0.61
Active deutonymph	2.88±0.25a	0.00	2.75±0.29a	0.00	1.75±0.29b	0.44	0.64
Quiescent deutonymph	2.00±0.41	0.00	1.75±0.29	0.00	1.38±0.48	-	-
Total immature stages	13.75±0.50a	46.15	12.25±0.29b	30.76	8.50±0.82c	0.92	1.33
Life cycle	18.13±0.48a		16.38±0.48b		12.38±0.85c	1.01	1.45
Pre-oviposition	2.25±0.29		2.00±0.41		1.75±0.29	-	-
Generation period	20.38±0.63a		18.38±0.85b		14.13±0.63c	1.14	1.64
Oviposition period	1.75±0.29c		3.00±0.416		8.88±0.48a	0.64	0.92
Post-oviposition	2.00±0.41		2.25±0.50		1.63±0.25	-	-
Longevity	6.00±0.41c		7.25±0.50b		12.25±0.50a	0.75	1.08
Life span	24.13±0.85		23.63±0.48		24.63±0.48	-	-
Average number of deposited eggs/female	5.50±0.58c		8.00±1.15b		64.00±1.83a	2.07	2.97
Reduction % of fecundity	91.41		87.50		00.00		

The plant extracts treatments resulted in considerable prolongation for the whole life-cycle periods of *T. urticae* (18.13 days for black cumin) and (16.38 days for wormseed) while it was 12.38 days for control. Similar results were obtained for the generation period for both. It was averaged 20.38 and 18.38 days for the corresponding plant extracts, compared with 14.13 days for the control.

From these results, the plant extracts shortened significantly the female adult longevity and the oviposition period of *T. urticae*, the means being 6.00 & 1.75 for black

cumin and 7.25 & 3.00 days for wormseed while the control gave 12.25 & 8.88 days respectively.

Total or average number of deposited eggs per female were highly affected when using the plant extracts against adult females of *T. urticae*, where it was equal to 5.5 and 8.00 eggs for black cumin and wormseed compared with 64.00 eggs for the control. The reduction percentage of fecundity were 91.41% and 87.50% for black cumin and wormseed respectively (Table 5).

It was evident that black cumin extract had stronger effect on adult of *T. urticae* than the extract of wormseed.

The results were in agreement with those recorded by (Schauer and Schmutterer, 1981; Barakat *et al.* 1985; Abo El-Ghar *et al.*, 1986; El-Halawany *et al.*1988; Dimetry *et al.* 1988; Amer *et al.*, 1989;Abo El-Ghar *et al.*, 1990 and Darwish, 1990) Nassar *et al.*, (1995) showed that after treatment the adult females of *T. urticae* with 500 and 1000 ppm. of *Duranta* and *Lantana* extracts, the average of life cycle durations were 10.8, 10.6, 12.68 and 9.40 days, respectively. The longevity periods of adult females of *T. urticae* were highly affected, as they averaged 5.46, 3.54, 10.67 and 6.06 days, compared with 15.57 of the control. The total number of deposited eggs per female were highly affected with *Duranta* and *Lantana* extracts, as it ranged between 1.47 and 23.87 eggs compared with 68.53 eggs for the control. Iskander *et al.* (1996). Showed that the biological aspects for *T. arabicus* were more affected by Shihh than Sorrel and Kalakh extracts.

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الملخص العربى

تأثير بعض المستخلصات النباتية كمبيدات أكاروسية على بعض الخصائص البيولوجية للاكاروس تترانيكس اورتيكا

وفاء حسن حجازى

معهد بحوث وقاية النباتات -محطة البحوث الزراعية بسخا

كفرالشيخ

وجهت الدراسة الحالية لتقييم النشاط الابادى لاثنان من المستخلصات النباتية (بذور حبة البركة والشيح الخرسانى) ضد آفة العنكبوت احمر (تترانيكس اورتيكا).

- ويمكن تلخيص النتائج التى تحققت من هذه الدراسة فى النقاط التالية:-

١-مستخلص حبة البركة كان اكثر سمية من مستخلص الشيح الخرسانى، حيث بلغت قيمة LC_{50} ٨٧٧ ، ١٨٦١,٣ جزء فى المليون على الترتيب على الإناث البالغة للعنكبوت الأحمر.

٢-مستخلص بذور حبة البركة والشيح الخرسانى كانت لهما سمية منخفضة على طور البيض عمر يوم ؛ يومين وثلاثة أيام حيث كانت قيمة LC_{50} لهذه المستخلصات هى ٦٧٤٤ ، ٨٠٢٧ ، ٥٠٥١ ، ٦٠١١ ، ٣٢١٩ ، ٤٩٤٩,٩ جزء فى المليون على الترتيب ويمكن القول أن السمية عالية على بيض الاكاروس عمر٧٢ ساعة يليه البيض عمر ٤٨ ساعة وفى النهاية البيض عمر ٢٤ ساعة.

٣- مستخلص حبة البركة والشيح الخرسانى كانا لهما تأثيرا عاليا فى خفض معدل وضع البيض للإناث البالغة للاكاروس.

٤-مستخلص حبة البركة كان له تأثيراً متوسطا على معدل فقس البيض الموضوع بينما مستخلص الشيح الخرسانى كان له تأثيرا منخفضا على معدل الفقس.

٥-المستخلص النباتى حبة البركة كان له تأثيرا متوسطا على تعقيم الإناث يليه مستخلص الشيح الخرسانى.

٦-وجد إن المستخلصات النباتية المستخدمة تطيل من فترة الأطوار الغير كاملة ، دورة الحياة ، فترة ما قبل وضع البيض ، وفترة الجيل بينما تقل طول فترة الحياة للإناث البالغة وفترة وضع البيض وكان مستخلص حبة البركة اشد تأثيرا من مستخلص الشيح الخرسانى