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Acaricidal effects of biocide compound, biofly (*Beauveria bassiana*) (Balsamo) and certain plant extracts on some biological aspects of two-spotted spider mite, *Tetranychus urticae* (koch.)

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ABSTRACT

The present study evaluated the residual effects of entomopathogenic fungi, *Beauveria bassiana* (Balsamo) and two plant extracts (black cumin and wormseed) on two-spotted spider mite, *Tetranychus urticae* (Koch.). Plant extracts were also evaluated when combined in mixtures with an acaricide fenpyroximate. Results indicated that Biofly was the highly toxic to adult female mites (LC_{50} 48403 conidia / ml). Black cumin extract had a moderate toxicity (LC_{50} 1861.3 ppm). Pronounced potentiation was observed when fenpyroximate mixed with the two tested plant extracts. Biofly was more toxic to older eggs than to younger ones (LC_{50} 23531, 29061.71 and 34951 conidia / ml, for 3, 2 and 1 days old eggs, respectively). Black cumin and wormseed were the least toxic compounds to treated *T. urticae* eggs (LC_{50} 6744, 8027, 5051, 6011, 3219 and 4949.91 ppm, respectively). Biofly had a little effect on mite fecundity, but black cumin and wormseed were highly reduced the number of eggs deposited. Black cumin had a moderate effect on egg-hatchability, while Biofly and wormseed extracts were the least effective ones. Black cumin had a moderate effect on sterility followed by wormseed and Biofly respectively. The tested plant extracts and Biofly 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.

Keywords: Acaricidal effect, Biocides, Biofly, Plant extract, Mite.

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. For all that, world are going to reduce chemicals use and trying to introduce predators and biocontrol agents such as virus, bacteria and fungi in I.P.M. programs.

Controlling phytophagous mites by a combination of biological and chemical methods has proved a less costly and more permanent method of control than have 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 against eggs, adult females and biological aspects of *Tetranychus 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, Sanmite, Ortus, Vertemic and Biomide) on some biological aspects of *T. cucurbitacearum*. All 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 compounds, however, vertimec was more harmful compared with 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.

Abdel-Samed (1998) studied the efficiency of the biocide compound, Biofly (3×10^7 conidia, at 100 cc/100 L of water) on different egg stages, adult females and some biological aspects of *Tetranychus urticae* (Koch). The results showed that the effect of this compound against egg stage was higher than against adult females. Moreover, three days old eggs were the most effectual of the others. The biological aspects of *T. urticae* when treated as an one day old eggs with Biofly indicated that the average number of deposited eggs per female decreased to 95.9 %. Moreover, it caused 90 % mortality during immature stages.

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 microbial pesticide (Biofly), plant extracts (black cumin and wormseed) and mixtures (fenpyroximate with plant extracts 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 two-spotted spider mite, *Tetranychus urticae* (Koch.) (Acari: Actinedida; 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:

Four compounds including microbial one were used:

* Fenpyroximate: (ortus) tert-butyl-(E)-α-(1,3 dimethyl-5-phenoxy-pyrazol-4-ylmethyleneamino-oxyl)=p-tolute, as 5 % S.C.
* Biofly: a trade name of the entomopathogenic fungus, *Beauveria bassiana* (Balsamo) as a liquid containing 3 x 10^7 conidia / ml.
* Two plant extracts (black cumin and wormseed).

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

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 100 gm, which was macerated in 300 ml of acetone / methanol (1 : 1 v / v) for 72 hours in dark bottle. During the maceration period sample was shaken for 6 hours using an electric shaker. Extract was filtered and placed in a refrigerator for 24 hr, the extract was then refiltered, dried over anhydrous sodium sulphate and evaporated to dryness using rotary evaporator. The residue was considered as the active

ingredient, weighted and dissolved in acetone to form the required concentrations. An amount of 5 g of black cumin seeds powder were extracted in 100 ml of absolute ethanol (75 %). Extraction was run over night followed by filtration.

3. Experimental techniques:

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

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

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

Where:

a = Unhatched eggs.

b = Total number of eggs which counted before dipping.

The joint action for tested compounds pairs was evaluated by the equation of co-toxicity factor, described by Mansour *et al.* (1966).

$$\text{Co-toxicity factor} = \frac{\text{Observed \% mortality} - \text{Expected \% mortality}}{\text{Expected \% mortality}}$$

This factor was used to differentiate the results into three categories; a positive factor of +20 or more is considered potentiation, a negative factor of -20 or more means antagonism and intermediate value between -20 or +20 was considered only an additive effect.

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

The residual effect of each tested compounds 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 eggs 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 adults females on each plant. In the case of plant extracts, the plants were infested with 5 adult females on teach plant, these plants dipped in the required concentration of plant extract. After the mites had become established and had laid eggs for one day, adult of *T. urticae* were removed and mortality was recorded. The stages present were counted from treated and untreated till adult stages. Data were statistically analyzed according to Finney (1952).

RESULTS AND DISCUSSION

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

The results (Table, 1) showed that extract of black cumin was more toxic than wormseed extract with LC_{50} values of 887 and 1861.3 p.p.m., respectively. Wormseed and black cumin have slope values of 1.67 and 1.25, respectively. 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 the affected organism.

Black cumin and wormseed extracts were toxic to the adult females of *T. urticae*, these results are in agreement with the findings of El-Halwany *et al.* (1988) who reported that cumin oil was more toxic for adult stage of *T. urticae* than other tested extracts. Iskander *et al.* (1996) found that Shihh 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*.

Data presented in Table (1) indicated that 2 mixtures of tested compounds showed different levels of potentiation.

1. Fenpyroximate with black cumin: +50.
2. Fenpyroximate with wormseed: +30.

Table (1): Toxicity of tested compounds and their mixtures against adult females of two-spotted spider mite, *T. urticae*.

Compounds	LC_{50} ppm	Slope Value	Confidence limits	Toxicity index	Co-toxicity factor
Pesticide					
Fenpyroximate	232.49	1.76	183.19-305.21	100	-
Plant extracts					
Black cumin	887	1.25	646-1253	26.21	+50**
Wormseed	1861.3	1.67	1277-2479	12.49	+30***
Biofly*	48403	1.19	32473-70831	-	-

* LC_{50} was determined as conidia/ml.
** Fenpyroximate with black cumin.
*** Fenpyroximate with wormseed.

Barkat *et al.* (1985) found that out of tested 90 mixtures of five pesticides and ten plant extracts to adult females of *T. urticae*, only 56 pairs showed potentiation, 2 pairs produced additive effect and 32 pairs disclosed antagonistic effect.

The joint action of the mixtures were found effective against *T. urticae* by many investigators in laboratory (Dewar and Haylock, 1995; Ahn *et al.*,

1996 and Ismail, 1997) and in field (Osman and Zaki, 1985; Abdel-All *et al.*, 1990 and Ahn *et al.*, 1996).

Results showed that the LC_{50} of Biofly was 48403 conidia / ml. The present results confirmed that the microbial pesticide was less toxic to *T. urticae.* Abdel-Samad (1998) indicated that the biocide compound (*B. bassiana*) at 3 x 10^4 conidia / ml was tested against the adult females of *T. urticae*, resulted in 45.69 mortality percentages. He found that again under field condition, the average reduction in population density of *T. urticae* was 71.06 % after the fourth application with *B. bassiana.*

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

The toxicity of different tested compounds 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 worm seed (plant-extracts) in a category of least effective compounds on all stages of eggs of spider mite with LC_{50} values of 6744, 8027, 5051 (1-day), 6011, 3219 (2-days) and 4949.91 p.p.m (3-day), respectively. Slope values of the log concentration-probit lines, indicate 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 homogenicity in 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 tested compounds 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.
Plant extracts									
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	4949.9	1.16	3996-6149
Biofly*	34951	0.93	26339-43603	29061.7	0.96	18431-38926	23531	0.94	12642-33106

* LC_{50} was determined as conidia/ml.

The toxic effect of entomopathogenic fungi, Biofly on eggs of two-spotted spider mite *T. urticae* at different stages, was showed in Table (2). It

is clear that the most ovicidal effect of Biofly was on eggs of 72 hours age (LC_{50} value 23531 conidia / ml), followed by eggs of 48 hours age (LC_{50} value of 29061.71 conidia / ml) and eggs of 24 hours age (LC_{50} value of 34951 conidia / ml).

It could be concluded that there is a negative relationship between number of conidia / ml enough to prevent 50 % of mite eggs to hatch and the egg age. In other words the biopesticide, Biofly, compound is more toxic to older eggs than to younger ones. The present results are in agreement with Abdel-Samad (1998) who found that Biofly was effective on different ages of eggs stages. Moreover, three days old eggs were the most effective than 2-days old eggs and one day old eggs. Also, Derbalah (1999) found that microbial pesticide Biofly was toxic at different ages 6, 12 and 24 hours. Moreover, eggs of 24 hours age were the more affected than 12 and 6 hours age eggs.

3. Effect of compounds residue on 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 adult 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. Biofly was almost the same effect as control treatment. 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, Biofly was of similar effects on egg deposition. Through the third day of egg deposition, Biofly was of similar effects on egg deposition and not significantly different from the control treatment. 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 discs treated by different compounds (Table 3), results suggested that plant extracts were the most effective compounds on egg deposition and Biofly was of little effect on this biological character.

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

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
Control		9.25 a	7.25 a	5.25 a	7.25 a	19.75 a	14.75 a	10.75 a	15.08 a
Microbial insecticide									
Biofly		7.75 b	5.50 b	4.50 a	5.92 a	15.00 b	10.25 b	7.25 b	10.83 b
L.S.D.	5%	0.93	1.12	0.80	1.98	1.13	1.39	1.10	7.87
	1%	1.29	1.55	1.11	21.73	1.57	1.92	1.52	10.87
Plant extracts									
Black cumin		4.00 c	3.25 c	2.25 b	3.17 b	15.25 b	10.00 c	6.25 c	10.50 b
Wormseed		5.50 b	4.25 b	2.75 b	4.17 b	17.00 b	11.00 b	7.25 b	11.75 b
Control		12.00 a	10.25a	7.00 a	9.75 a	19.75 a	14.50 a	9.75 a	14.67 a
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

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. Derbalah (1999) showed that Biofly had a little effect on rate of egg deposition.

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, wormseed and Biofly were the least effective compounds on egg hatchability of *T. urticae*. The present results are 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.

Biofly was the least effective compound on the total number of eggs laid. The female egg production capacity decreased by 18.39 %. 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.

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
Microbial pesticide	17.75	18.39	70.77	41.31
Biofly	21.75	-	98.41	-
Control				
Plant extracts	9.50	67.52	68.75	77.26
Black cumin	12.50	57.26	78.33	65.91
Wormseed	29.25	-	98.18	
Control				

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

Biofly was the least effective compound and the percentage of sterility in mated females was 41.31. 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 extracts with (LC_{25}) on the biological aspects of *T. urticae*:

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

The results in Table (5) showed that the black cumin and 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 treatments 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.

Developmental stages	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 larva	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±0.41b		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 day 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 control gave 12.25 & 8.88 days respectively.

Average numbers of deposited eggs per female was highly affected when using the plant extracts against adult females of *T. urticae* equal 5.50 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 extract of wormseed.

These previous results are in agreement with that 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, 10.6,1 2.68 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 of *T. arabicus* were more affected by Shihh than Sorrel and Kalakh extracts.

5. The residual effect of Biofly on biological aspects of *T. urticae*:

The residual effect of Biofly with 3 x 10^4 conidia / ml (recommended dose) on the biology of adult females *T. urticae* was studied. The

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

Results showed that the incubation period was slightly increased to 5.13 days compared with 4.88 days for control. The duration of active and quiescent larvae were increased to 3.75 and 1.25 days, respectively, compared with 2.5 and 0.88 days for control. The duration of the active and quiescent protonymphs were increased to 2.5 and 1.5 days compared with 1.63 and 1.13 days for control, respectively. The aspects for active and quiescent deutonymphs were 2.0 and 1.25 days compared with 1.88 and 0.75 days for control. The duration of the total immature stages was increased to 12.25 days compared with 8.75 days of the control, respectively. The mortality percentages were 31.25, 17.5, 3.75 and 2.5 in active larvae, active protonymphs, active deutonymphs and quiescent deutonymphs of *T. urticae* respectively (Table 6).

Generally, the total mortality percentage was 55 % during the all immature stages.

The life cycle, pre-oviposition and generation period were prolonged more than control. They were 17.38, 1.75 and 19.13 days for the above mentioned periods, while they were 13.63, 1.13 and 14.75 days for the control, respectively.

The oviposition period was highly decreased to 2.5 days while it was 7.25 days in the control. The reduction in the number of the deposited eggs per the resulting female was 11.00 eggs compared with 55.00 eggs for the control. The reduction percentage of fecundity was 80 %. The present results were in agreement with the findings of Abdel-Samad (1998).

Table (6): Effect of Biofly on the biological aspects of *T. urticae* treated with 3 x 10^4 conidia/ml.

Developmental stages	Duration (in days)	Mortality (%)	Control duration (in days)
Incubation period	5.13±0.25		4.88±0.25
Active larva	3.75±0.5	31.25	2.5±0.58
Quiescent larvae	1.25±0.29	00.00	0.88±0.25
Active protonymph	2.5±0.58	17.5	1.63±0.48
Quiescent protonymph	1.5±0.58	00.00	1.13±0.25
Active deutonymph	2.00±0.41	3.75	1.88±0.25
Quiescent deutonymph	1.25±0.29	2.5	0.75±0.29
Total immature stages	12.25±0.65	55	8.75±0.65
Life cycle	17.38±0.48		13.63±0.63
Pre-oviposition	1.75±0.29		1.13±0.25
Generation period	19.13±0.48		14.75±0.65
Oviposition period	2.5±0.58		7.25±0.65
Post-oviposition	2.00±0.41		1.75±0.29
longevity	6.25±0.5		10.13±0.85
Life span	23.63±0.63		23.75±1.44
Average number of deposited eggs/female	11.00±0.82		55.00±1.41
Reduction % of fecundity	80		00.00

6. The residual effect of Biofly on biological aspects of *T. urticae* after treated one day old eggs:

Results in Table (7) showed that the Biofly treatment with 3 x 10^4 conidia/ml (recommended dose) significantly increased the incubation period of the eggs followed by Biofly with (LC_{25}) 2.42 x 10^4 conidia/ml. The incubation period of eggs lasted for 4.75 and 4.13 days for Biofly 3 x 10^4 and 2.1 x 10^4 conidia / ml, respectively, compared with 4.00 days of the control. The duration of active larvae and protonymph were increased to 4.63 & 4.13 and 3.00 & 2.00 days for Biofly 3 x 10^4 and 2.1 x 10^4 conidia / ml compared with 1.38 and 1.50 days for the control respectively. The mean periods of the immature stages were 15.88 and 11.88 days for Biofly with 3 x 10^4 and 2.1 x 10+4 conidia / ml, respectively, compared with an average of 7.56 days for the control (Table 7). The mortality percentage were 50 & 25 & 8.33 & 4.17 and 22.22 & 13.89 & 2.79 & 2.79 in the active larvae, active protonymphs, active deutonymphs and quiescent

deutonymphs with treatment Biofly 3x 10^4 and 2.1 x 10^4 conidia / ml on *T. urticae*, respectively.

The life cycle, pre-oviposition and generation period were 20.63 & 2.00 & 22.63 and 16.00 & 1.25 & 17.25 day for Biofly with 3 x 10^4 and 2.1 x 10^4 conidia / ml, respectively, compared with 11.56 & 1.13 & 12.69 days for the control, respectively. There were significant differences between Biofly 3 x 10^4, 2.1 x 10^4 conidia / ml and control.

Table (7): The residual effect of Biofly on the biological aspects of *T. urticae*.

Developmental stages	Biofly				Control	LSD	
	Duration (in days)	*Mortality (%)	Duration (in days)	** Mortality (%)	duration (in days)	5%	1%
Incubation period	4.75+0.29^a		4.13+0.25^b		4.00+0.41^b	0.51	0.72
Active larva	4.63+0.48^a	50	3.25+0.29^b	22.22	1.38+0.48^c	0.68	0.98
Quiescent larvae	1.50+0.58	00.00	1.13+0.25	00.00	0.88+0.25	-	-
Active protonymph	4.13+0.63^a	25	3.00+0.41^b	13.89	1.50+0.58^c	0.87	1.26
Quiescent protonymph	1.38+0.48^a	00.00	1.13+0.25	00.00	0.94+0.31	-	-
Active deutonymph	2.50+0.58	8.33	2.00+0.41	2.79	1.75+0.29	-	-
Quiescent deutonymph	1.75+0.29^a	4.17	1.38+0.25^{ab}	2.79	1.13+0.25^b	0.42	0.61
Total immature stages	15.88+1.70^a	87.5	11.88+0.75^b	41.69	7.56+0.92^c	1.92	2.75
Life cycle	20.63+1.89^a		16.00+0.58^b		11.56+0.77^c	1.96	2.81
Pre-oviposition	2.00+0.41^a		1.25+0.29^b		1.13+0.25^b	0.522	0.74
Generation period	22.63+1.49^a		17.25+0.65^b		12.69+0.55^c	1.59	2.28
Oviposition period	1.00+0.41^c		3.75+0.29^b		8.75+0.50^a	0.65	0.94
Post-oviposition	2.50+0.58^a		2.00+0.41^{ab}		1.38+0.48^b	0.79	1.13
longevity	5.50+0.41^c		7.00+0.41^b		11.25+0.50^a	0.71	1.01
Life span	26.13+1.79^a		23.00+0.41^b		22.81+0.38^b	1.74	2.49
Average number of deposited eggs/female	4.00+0.823^c		20.00+0.82^b		61.50+1.29^a	1.60	2.30
Reduction % of fecundity	93.49		67.48		00.00		

* Recommended dose (3 x 10^4 conidia/ml)
** Level LC_{25} = 2.1 x 10^4 conidia/ml.

From the results in Table 7, it was found that Biofly significantly shortened the adult female longevity and the oviposition period of *T. urticae*; the means being 5.50 & 1.00 and 7.00 & 3.75 days for Biofly 3 x 10^4 and 2.1 x 10^4 conidia / ml, respectively, compared with a mean of 11.25 & 8.75 days for the control.

Data also showed that the average number of deposited eggs per female were highly affected with Biofly 3 x 10^4 and 2.1 x 10^4 conidia / ml, values were 4 and 20 eggs, respectively, compared with 61.50 eggs for the control.

The reduction percentage of fecundity were 93.49 % and 67.48 % for Biofly 3 x 10^4 and 2.1 x 10^4 conidia / ml, respectively.

The present results are in agreement with the findings of Abdel-Samad (1998) who found that the biological aspects of *T. urticae* when treated one day old eggs with Biofly indicated that the average number of deposited eggs per female decreased to 95.95 %. Moreover, it caused 90 % mortality during immature stages.

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تأثير المبيد الميكروبى بيوفلاى وبعض المستخلصات النباتية كمبيدات أكاروسية على بعض الخصائص البيولوجية للأكاروس تترانيكس أورتيكا

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وجهت الدراسة الحالية لتقييم النشاط الإبادى للمبيد الحيوى (البيوفلاى) وهو مستحضر من فطر *B. bassiana* واثنان من المستخلصات النباتية (بذور حبة البركة والشيح الخرسانى) ضد آفة العنكبوت الأحمر ذو البقعتين (تترانيكس أورتيكا) - وكذلك تقييم التأثير المشترك للمبيد الأكاروسى الفنبيروكسيميت فى مخلوط منه مع المستخلصات النباتية.

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

١- المبيد الحيوى (بيوفلاى) كانت سميته عالية على الإناث البالغة وكانت LC_{50} (٤٨٤٠٣ كونيديا / مل).
٢- مستخلص حبة البركة كانت سميته متوسطة حيث بلغت قيمة LC_{50} ٨٧٧ جزء فى المليون بينما المستخلص النباتى (الشيح الخرسانى) كان أقل المركبات سمية على الإناث البالغة للعنكبوت الأحمر حيث بلغت قيمة LC_{50} ١٨٦١ جزء فى المليون.
٣- بدراسة التأثير المشترك لخلائط المبيد مع المستخلصات النباتية وجد أن المستخلصات النباتية أدت إلى تنشيط فعل المبيد وكان التنشيط واضحا.
٤- كانت سمية المبيد الحيوى (بيوفلاى) عالية على بيض الأكاروس عمر ٧٢ ساعة وكانت قيمة LC_{50} ٢٣٥٣١ كونيديا / مل ثم تلاه فى التأثير السام للبيض عمر ٤٨ ساعة من وضعه حيث كانت LC_{50} ٢٩٠٦١,٧١ كونيديا / مل بينما كانت سميته منخفضة على البيض عمر ٢٤ ساعة من وضعه حيث كانت LC_{50} ٣٤٩٥١ كونيديا / مل.
٥- مستخلص بذور حبة البركة والشيح الخرسانى كانت لهما سمية منخفضة على طور البيضة 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.
٦- البيوفلاى كان تأثيره ضعيف على خصوبة الإناث البالغة للأكاروس بينما مستخلص حبة البركة والشيح الخرسانى كانا لهما تأثيرا عاليا فى خفض معدل وضع البيض.
٧- مستخلص حبة البركة كان له تأثيرا متوسطا على معدل فقس البيض الموضوع بينما البيوفلاى ومستخلص الشيح الخرسانى كانا لهما تأثيرا منخفضا على معدل الفقس.
٨- المستخلص النباتى حبة البركة كان له تأثيرا متوسطا على تعقيم الإناث يليه مستخلص الشيح الخرسانى بينما كان البيوفلاى أقلهم تأثيرا.
٩- وجد أن المستخلصات النباتية المستخدمة والبيوفلاى تطيل من فترة الأطوار الغير كاملة، دورة الحياة، فترة قبل وضع البيض وفترة الجيل بينما تقل طول فترة الحياة للإناث البالغة وفترة وضع البيض وكان مستخلص حبة البركة أشد تأثيرا من مستخلص الشيح الخرسانى.