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Accummulation Effects of Chemical and Organic Fertilizers on *Tetranychus urticae* koch and *Phytoseiulus persimilis* A.-H. under Laboratory Conditions

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ABSTRACT

The toxicity effects of treating the four chemical and organic fertilizers 'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' compared with the recommended compound 'Ortus' were tested on the two-spotted spider mite, *Tetranychus urticae* Koch and its predatory mite, *Phytoseiulus persimilis* A.-H. under laboratory conditions. The accumulation mortality percentages of *T. urticae* and *P. persimilis* were recorded after 24, 48 and 72 hours from treatment, increased gradually with increasing time of the five aforementioned tested. Comparing between the effects of the five tested compounds on the immatures, adult females and eggs of *T. urticae* and its toxicity on the predator *P. persimilis* after24, 48 and 72 hours from treatment were compared. Ortus recorded the highest effect, followed by Potassen and Animal Manure + Neem Manure; while Animal Manure and Novatreen gave the least effect. LT_{50}, LT_{90} and slop values of *T. urticae* and its predatory *P. Persimilis* were calculated, and can be concluded that *P. Persimilis* gave more tolerance against the five tested compounds than *T. urticae*.

Key words: *Tetranychus urticae, Phytoseiulus persimilis,* Chemical, Organic, Fertilizer.

INTRODUCTION

The two spotted-spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) is a major economic pest attacking several kinds of field crops and vegetables especially cotton, strawberry, cucumber and cantaloupe in Egypt. The appearance of plant infectedwith mites appears on the plant parts especially leaves. Its damage results from, feeding and removal of plant juices that causes plants to have small red or bronzed leaves that may dry and fall off due to heavy infestations. It affects the quality and quantity of the yield crops. Combining tactics involving reduced-risk pesticides and selective releases of predatory mites may yield more acceptable control of the two-spotted spider mite; while maintaining predatory mite populations in the field (Rhodes *et al*., 2006), The predatory mite *Phytoseiulus persimilis* (Athias-Henriot) is an economically important species in integrated pest management and biological control of spider mites in many countries throughout the world,so It is important to know if acaricides have adverse undesirable effects on the predatory mites (Nadimi *et al*., 2008).Several acaricides including flufenoxuron, fenpyroximate and abamectin are currently used in Egypt. However, the side effects of the acaricides to key spider mite predator including *P. persimilis* are unidentified Abd-Elhady and Heikal (2011). In many cases, the combined use of chemical and biological control might provide the best approach for both managing pest populations and minimizing selection for resistance (Gentz *et al*., 2010). Fertilizers are usually added to the soil; but it is known that the plants can absorb nutrition which is applied directly into the leaves. The possibility of killing other insects by plant nutrient supplements is to be explored further (Sung-Ching, 1995). Insect pests of the plant that received foliar spray of compost extracts were minimal compared with non-fertilized plants and those that received soil incorporated NPK fertilizer. This suggests a dual role of this compost extract foliar sprays as source of nutrients and materials for controlling insect pests (Akanbi, 2007).

The present work aims to study the accumulation toxicity effects of chemical and organic fertilizers on the two-spotted spider mite, *Tetranychus urticae* Koch and its predatory mite, *Phytoseiulus persimilis* A.-H. under laboratory conditions.

MATERIALS AND METHODS

Mites tested culture

The original populations of *T. urticae* and its predator were obtained from stock cultures maintained in two separated greenhouses belonging to Plant Protection Research Institute at Dokki district (Giza governorate) and reared under laboratory conditions at 25±2°C and 65±5% R.H. on kidney bean plants, *Phaseolus vulgaris* (L.).The predacious mite *Phytoseiulus persimilis* Athias-Henriot was reared in plastic boxes (26 x 15 x 10 cm), a cotton pad was put in the middle of each box, provided with water as a barrier to prevent predatory mite individuals from escaping in addition to a tangle foot strip at the box edges. Highly infested bean leaves with *T. urticae* were provided as food sources to the predacious mite in the laboratory. Individuals of *P. persimilis* (Athias-Henriot) were obtained from its mass rearing on spider mites *T. urticae* Koch on bean plants in a greenhouse $60\times9m^2$ about 540 m^2 (El-Halawany *et. al.*,2000 ; Heikal and Ibrahim, 2002).

Tested compounds:

The compounds used in the present experiments were:

- Ortus 5%.
- Animal Manure 10% (AM).
- Animal Manure 10% + Neem Manure 10% (ANM).
- Potsasen foliar fertilizer spray (0.16%) contains K 30% + P 8%.
- Novatreen foliar fertilizer spray (0.33%) contains N 8 % + P 5% + K 5% + cleat Fe 0.4 % + cleat Zn 0.3 % + Mn 0.3 % + B 0.05 + Mo 0.3%.
- Control with water.

Method of application

The effect of different compounds were evaluated under laboratory conditions. All treatments of the toxic effect of the tested materials on the two-spotted spider mite, *T. urticae* Koch and its predatory mite, *P. persimilis* A.-H..All were occurred by leaf disc dip technique according to Siegler (1947). Diluted suspensions of different concentrations of these compounds were prepared by distilled water for comparing. Discs (2 cm diam.) of kidney bean leaves were then dipped in each concentration and others in distilled water (control) for, 5 seconds and left to dry.

***T. urticae* mortality**

Twenty of each immature stages, adult females and eggs of the two spotted spider mites were transferred to the lower surface to each disc of kidney bean leaf (20 individuals/leaf disc) treated previously.

***P. persimilis* mortality**

Twenty adult females and eggs of the predacious mite*P. persimilis*were transferred to each kidney bean leaf disc (5 cm in diameter) treated previously, using a brush. The discs were placed on a moist filter paper, rested on a moist cotton wool pads in Petri dishes. A number of *T. urticae* were added as a food for *P. persimilis*. Each treatment was replicated four times. Mortality was recorded after 24, 48 and 72hours post treatments.

Statistical analysis

The natural mortality was corrected according to Abbott's formula (1925).The corrected percent mortalities were statistically compounded according Finney (1971) and plotted on probit analysis paper. The tested compounds were compared for its efficacy on the mite and its predator according to their LC_{50}, LC_{90} and slopes of the toxicity lines. Toxicity index of tested compounds were determined according to Sun (1950).

RESULTS AND DISCUSSION

Accumulation toxicity of chemical and organic fertilizers on *T. urticae* basis on Percent mortality

According to the obtained data (Table 1), different mortality percentages were recorded, when immature stages of *T. urticae* were treated with different chemical and organic fertilizers'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' compared with recommended compound 'Ortus'; the mortality percentages were 50.0, 33.3, 36.7 and 36.7% after 24hours, respectively ; while was 70.0, when treated with Ortus. The accumulation percent reduction after 48 hours were 73.30, 64.13, 64.70 and 62.27%, respectively; while reached 85.57% in case of Ortus against *T. urticae* immature stages. Accumulation effects of these compounds after 72 hours reached 76.6, 86.76, 91.17 and 62.27% reduction, respectively compared with Ortus (94.47%).

On the other hand, females of *T. urticae* treated with different chemical and organic fertilizers'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen comparing with recommended compound 'Ortus' gave mortality percentages reached 43.30, 20.0, 26.67 and 40.0% after 24 hours, respectively; while reached 60.0% when treated with Ortus. The accumulation percent reductions after 48 hours were 63.0, 50.0, 32.24 and 58.90%, respectively; while reached 74.47% in case Ortus compound against adult females of *T. urticae*, whereas, accumulation effects of these compounds after 72 hours reached 73.3, 80.0, 81.14 and 71.13% reduction, respectively comparing with Ortus (87.80%).

Against *T. urticae* egg stage 'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' compared with recommended compound 'Ortus' gave little effects against eggs; the mortality percentages were 5.0, 6.7, 1.7 and 5.0% after 24 hours, respectively; while reached 30.0% when treated with Ortus. The accumulation percent reduction after 48 hours were 31.7, 27.0, 31.7 and 15.0%, respectively; while reached 55.0% in case of Ortus compound against eggs of *T. urticae*; whereas, accumulation effects of these compounds after 72 hours reached 55.03, 61.67, 53.36 and 35.0% reduction, respectively compared with 85.0% for Ortus.

The obtained results agree with those obtained by El-Khateeb *et al.* (2004) who evaluated the effectiveness of some new safe chemicals against the moving stages of *T. urticae*. They found that (Dipel 2X (*Bacillus thuringiensis*) at 50 g, S -1283 at 150 ml) and Three Targets (plant oils, fatty acids and essential micronutrients) at 500 ml/100 litters of water gave percent reduction 74.98, 75.82% , 73.70, 74.86 and 74.53%, respectively. Three Targets at the lowest rate of 250 ml/100 litters water were the least effective material with 67.9, 68.03 and 68.80%

Table (1): Accumulation mortality percentages of different chemical and organic fertilizerson the two-spotted spider mite, *Tetranychus urticae* Koch under laboratory conditions.

Material	Stage	Periods after treatment					
		24 h		48 h		72 h	
		Mean No.	%Mortality	Mean No.	%Mortality	Mean No.	%Mortality
Ortus	Immatures	7.00	70.00	8.67	85.57	9.67	94.47
	Adult	6.00	60.00	7.57	74.47	9.27	87.80
	Egg	3.0	30.0	8.0	55.0	15.33	85.00
AM	Immatures	5.00	50.00	2.33	73.30	8.33	76.60
	Adult	4.33	43.30	6.33	63.00	7.66	73.30
	Egg	0.3	5.0	5.6	31.7	11.33	55.03
ANM	Immatures	3.33	33.30	6.33	64.13	9.00	86.76
	Adult	2.00	20.00	5.33	50.00	8.66	80.00
	Egg	1.3	6.7	6.0	27.0	16.00	61.67
Potassen	Immatures	3.67	36.70	7.0	64.70	9.67	91.17
	Adult	2.67	26.67	5.34	32.24	8.34	81.14
	Egg	0.3	1.7	6.3	31.7	11.67	53.36
Novatreen	Immatures	3.67	36.70	7.00	62.27	7.67	62.27
	Adult	4.00	40.00	6.00	58.90	7.33	71.13
	Egg	1.0	5.0	3.0	15.0	8.00	35.00
Control	Immatures	0.00	-	0.11	-	0.22	-
	Adult	0.00	-	0.11	-	0.22	-
	Egg	0.00	-	0.0	0.00	1.00	-

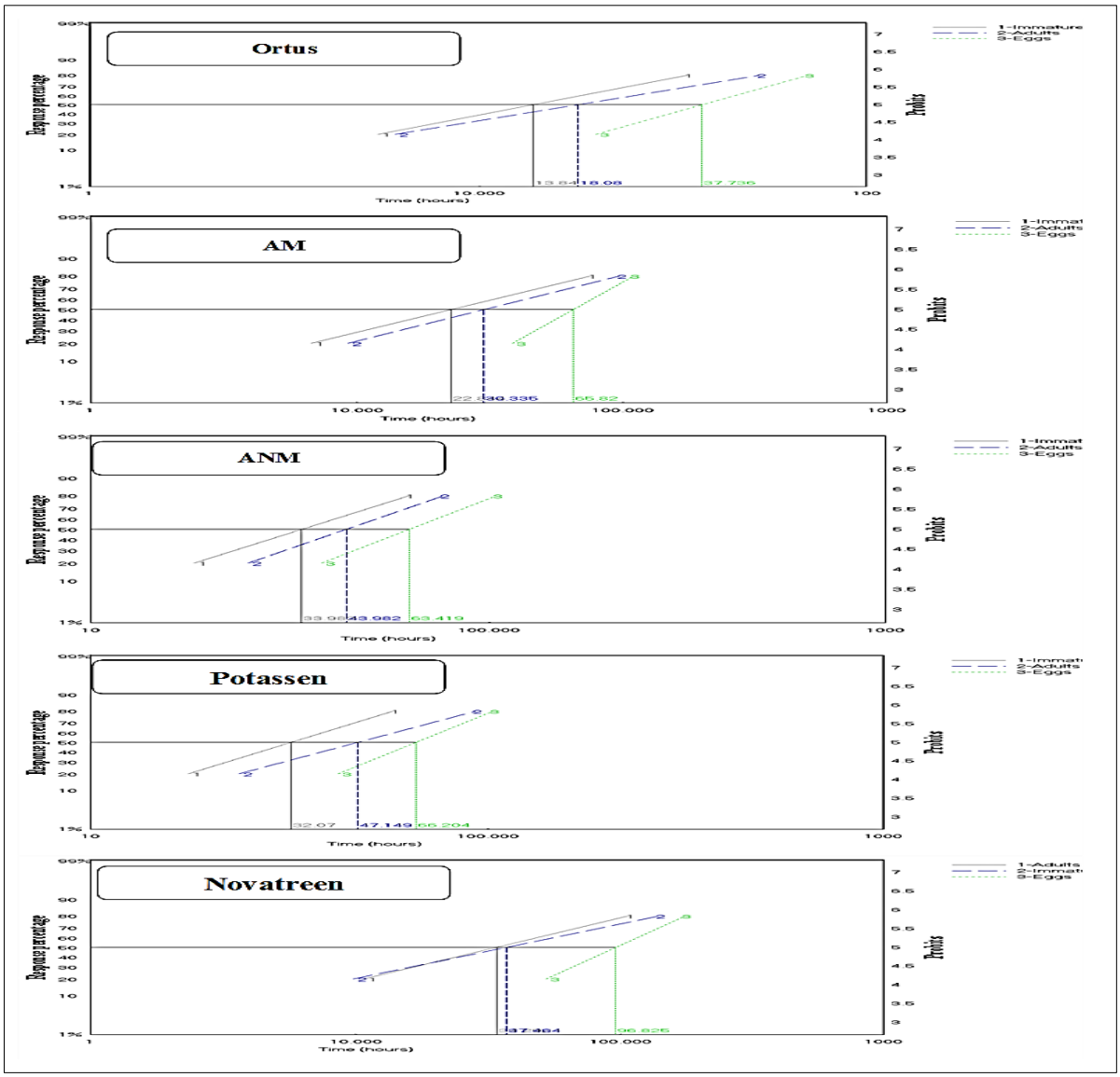

Fig. (1): LT values of different chemical and organic fertilizerson *Tetranychus urticae* at different intervals under laboratory conditions.

Table (2): LT values and slopes of different chemical and organic fertilizerson the two-spotted spider mite, *Tetranychus urticae* Koch and the predatory mite, *Phytoseiulus persimilis* A.-H. after different intervals under laboratory conditions.

Compound	*Tetranychus urticae*								
	Immatures			Adults			Eggs		
	Slope	LT_{50}	LT_{90}	Slope	LT_{50}	LT_{90}	Slope	LT_{50}	LT_{90}
Ortus	2.1079	13.840	56.123	1.7927	18.080	93.774	3.0723	37.736	98.605
AM	1.6004	22.844	144.397	1.6401	30.335	183.388	3.6871	65.820	146.536
ANM	3.1179	33.982	87.560	3.4394	43.982	103.727	3.8349	63.419	136.903
Potassen	3.2497	32.070	79.520	2.8200	47.149	134.258	4.3181	66.204	131.124
Novatreen	1.4543	37.464	285.018	1.6826	34.292	198.088	3.2027	96.825	243.302

Table (3): Accumulation mortality percentages of different chemical and organic fertilizers on the predatory mite, *Phytoseiulus persimilis* A.-H.under laboratory conditions.

Material	Stage	Periods after treatment					
		24 h		48 h		72 h	
		Mean No.	%Mortality	Mean No.	%Mortality	Mean No.	%Mortality
Ortus	Adults	2.33	23.30	6.33	59.97	8.33	79.97
	Eggs	2.3	11.7	5.6	28.4	13.33	65.00
AM	Adults	2.00	20.00	3.67	33.33	5.67	53.33
	Eggs	1.7	8.3	5.0	25.0	9.33	45.00
ANM	Adults	1.33	16.67	3.0	30.00	4.33	43.33
	Eggs	2.3	11.7	4.3	21.7	6.67	31.67
Potassen	Adults	1.33	13.33	3.33	30.00	3.67	33.33
	Eggs	0.0	0.0	1.7	8.3	3.67	16.67
Novatreen	Adults	1.00	10.00	3.00	26.67	4.00	36.67
	Eggs	0.0	0.0	1.0	5.0	3.00	13.33
Control	Adults	0.00	-	0.00	-	0.00	-
	Eggs	0.0	-	0.00	-	0.33	-

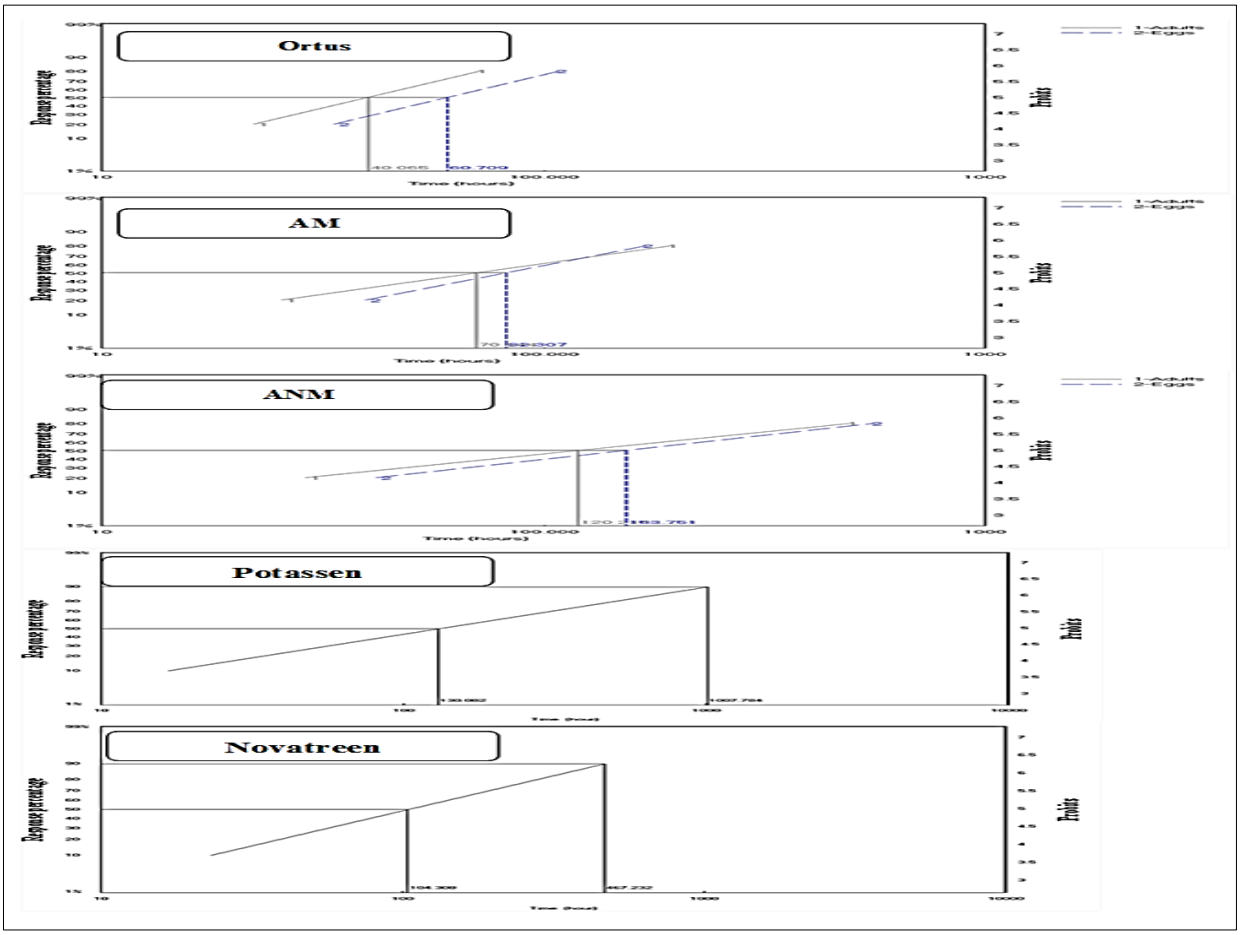

Fig. (2): LT values of different chemical and organic fertilizers on the predatory mite, *Phytoseiulus persimilis* A.-H. at different intervals under laboratory conditions.

reduction (Table1).

Lethal time values

The recorded values of LT_{50} and LT_{90} represented in Table (2) and illustrated in Fig. (1) showed the lethal time of immatures, adult females and eggs of *T. urticae* under laboratory conditions to the tested compounds after 72 hours.

Table (2) and Fig. (1)indicated that, the corresponding LT_{50} values of *T. urticae* immatures after 72 hours when treated with some chemical and organic fertilizers'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' compared with the recommended compound 'Ortus'were 22.844, 33.982, 32.070, 37.464 and 13.840 and the corresponding LT_{90} values were 144.397, 87.560, 79.520, 285.018 and 56.123hours, respectively.

The slope of line is useful to known the homogeneity of different stages (immatures, adult females and eggs) of *T. urticae*, which reared under laboratory conditions and response to different compounds.

The slope of *T. urticae* immatures were 1.6004, 3.1179, 3.2497, 1.4543 and 2.1079 after 72 hours when treated with Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen compared with 'Ortus', respectively.

For adult females of *T. urticae*, the corresponding LT_{50} values after 72 hours of treated compounds were 30.335, 43.982, 47.149, 34.292 and 18.080 hours, respectively, whereas, LT_{90} were 183.388, 103.727, 134.258, 198.088 and 93.774 hours, respectively after treated with the aforementioned fertilizers, respectively.

Table (2) and Fig. (1)show that the slope of adult females of *T. urticae* were 1.6401, 3.4394, 2.8200, 1.6826 and 1.7927after 72 hours when treated with Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen compared with recommended compound 'Ortus', respectively.

For *T. urticae* eggs, the corresponding LT_{50} values after 72 hours of treated compounds were 65.820, 63.419, 66.204, 96.825 and 37.736 hours, respectively, whereas, LT_{90} were 146.536, 136.903, 131.124, 243.302 and 98.605 hours, respectively after treated with Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' compared with Ortus.

Table (2) and Fig. (1) show that the slope of *T. urticae* eggs were 3.6871, 3.8349, 4.3181, 3.2027 and 3.0723 after 72 hours when treated with Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen compared with Ortus, respectively.

Accumulation toxicity of different chemical and organic fertilizers on predatory mite, *P. Persimilis* basis on

Percent mortality

According to the obtained results in Table (3), toxicity effects were recorded when *P. Persimilis* immatures were treated with different chemical and organic fertilizers'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' comparing with recommended compound 'Ortus'; the toxicity effects were 20.0, 16.67, 13.33 and 10.0% after 24 hours, respectively with Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen; while was 23.3%, when treated with Ortus; while the accumulation percent reduction after 48 hours were 33.33, 30.0, 30.0 and 26.67%, respectively; while reached to 59.97% for Ortus compound against the adults of *P. Persimilis;* whereas, accumulation effects of these compounds after 72 hours reached to 53.33, 43.33, 33.33 and 36.67% toxicity effects, respectively compared with Ortus (79.97%).

Against eggs of *P. Persimilis* chemical and organic fertilizers'Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen' compared with recommended compound 'Ortus' gave little or no effects against eggs; Animal Manure and Animal Manure + Neem Manure gave 8.3, 11.7% toxicity effects after 24 hours, respectively; while Potassen and Novatreen didn't have any toxicity effects; while Ortus gave 23.30% ; whereas, the accumulation toxicity effects after 48 hours were 25.0, 21.7, 8.3 and 5.0%, respectively; while reached to 28.4% for Ortus compound against eggs of *P. persimilis,* whereas, accumulation effects of these compounds after 72 hours reached to 45.0, 31.67, 16.67 and 13.33% toxicity effects, respectively compared with Ortus (65.0%).

The obtained results with are harmony with those obtained by Ismail *et al.* (2009) who reported that abamectin was the most effective compound on adult females of predator mite *P. persimilis* adult femal followed by Cyhalothrin and ethion. Chlorfenapyr had a moderate toxic effect; while black cumin extract and mineral oil (Nat1) were the least toxic compounds to adult females of *P. persimilis.*

Lethal time values

The recorded values of LT_{50} and $LT_{90's}$ represented in Table (4) and illustrated in Fig. (2) showed the lethal time of *P. Persimilis* adults and eggs under laboratory conditions to the tested compounds after 72 hours.

Data in table (4) and fig. (2) indicated that, the corresponding LT_{50} values of *P. Persimilis* adults stages of after 72 hours when treated with Animal Manure, Animal Manure + Neem Manure, Potassen

Table (4): LT values and slopes of different chemical and organic fertilizerson the predatory mite, *Phytoseiulus persimilis* A.-H. after different intervals under laboratory conditions.

Compound	*Phytoseiulus persimilis*					
	Adults			Eggs		
	Slope	LT_{50}	LT_{90}	Slope	LT_{50}	LT_{90}
Ortus	3.2821	40.065	98.457	3.2982	60.709	148.534
AM	1.9060	70.544	331.805	2.6512	82.307	250.518
ANM	1.3630	120.238	1047.958	1.4922	153.751	1110.993
Potassen	1.4414	130.082	1007.784	-	-	-
Novatreen	1.9680	104.308	467.232	-	-	-

and Novatreen compared with 'Ortus' were 70.544, 120.238, 130.082, 104.308 and 40.065 hours after 72 hours and the corresponding LT_{90} values were 331.805, 1047.958, 1007.784, 467.232 and 98.457 hours, respectively.

The slope of line is useful to known the homogeneity of different stages (adults and eggs) of *P. persimilis*, which reared under laboratory conditions and response to different compounds.

Data in Table (4) and Fig. (2) showed that the slope of *P. Persimilis* adults were 1.9060, 1.3630, 1.4414, 1.9680 and 3.2821 after 72 hours when treated with Animal Manure, Animal Manure + Neem Manure, Potassen and Novatreen compared with recommended compound Ortus, respectively.

On the *P. persimilis* eggs, the corresponding LT_{50} values after 72 hours of treated compounds were 82.307, 153.751 and 60.709 hours, respectively, whereas, LT_{90} were 250.518, 1110.993 and 148.534 hours, respectively after treated with Animal Manure, Animal Manure + Neem Manure compared with Ortus.

Table (4) and Fig. (2) show that the slope of *P. persimilis* eggs were 2.6512, 1.4922 and 3.2982 after 72 hours when treated with Animal Manure, Animal Manure + Neem Manure comparing with recommended compound Ortus, respectively.

Thus, successive foliar sprays of plant nutrients and foliar fertilizers in aqueous solutions of extreme pH values, without employing toxic organic materials were found. Repeatedly applied sprays causing the pH changes provide an effective, cheap, and environmentally friendly way of fighting plant pests.The pH on the leaves after spraying gradually returns from the extreme value towards neutrality in few hours (Dimenstein and Nes, 2013).

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