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LABORATORY SUSCEPTIBILITY OF DIFFERENT STAGES OF THE SPOTTED SPIDER MITE *Tetranychus urticae* TO ACARICIDES.

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ABSTRACT

This study was carried out to investigate the efficacy of tested compounds against mite-eggs to select the most potent compounds of ovicidal action to be used in the field prior to build up of injury from larval and adult stages of mite. The ovicidal action of 12 pesticides namely: nomite, fenpyroximate, dicofol M, neoron, dicofol, vertimec, propargite, chlorfenapyr, meothrin, fenazaquin, pegasus and selecron were tested against 1,2,3,4 days old eggs of the mite *T. urticae*. Toxicity of the tested compounds were also evaluated against larvae, deutonymph and adults of *T. urticae*. The results indicated that: Fenpyroximate was the most potent compound against all embryonic developmental stages of eggs, followed by nomite and vertimec, while pegasus was the lowest one. The susceptibility of eggs to all compounds increased as the age of eggs increased. The data also showed that fenpyroximate was the most efficient compound followed by dicofol and dicofol-M while pegasus was the lowest one, against larval and deutonymphal stages. The data obtained on the adult female stage showed that vertimec was the most potent compound followed by dicofol-M, nomite, fenpyroximate, dicofol, selecron, chlorfenapyr, neoron, meothrin, fenazaquin, propargite and in the end diafenthiuron which was the lowest effective pesticide against all stages.

INTRODUCTION

Tetranychid mite is one of the major pest causing damage to field, horticulture and vegetable crops. *Tetranychus urticae* was the most important species which cause an economic loss to our crops in Egypt. A wide range of chemicals have been marketed for control of this two-spotted spider mite. The susceptibility testing methods on different stages of mites to acaricides had been carried out by many investigators.

Some chemicals may inhibit AChE in late stages of embryonic development (Smith and Wagenknecht, 1959). In the same time it was reported that the effect of an insecticide to eggs of mite may vary according to the egg age (Smith and Salked,1966).

On the other hand, some other groups of miticides may show high and predominant ovicidal activity against eggs of the two-spotted spider mite in all stages of embryonic development (Staal *et al.*1975).
Hosny *et al.* (1998) found that kelthane and tedion were the most toxic compounds against adult females of the two-spotted spider mite *T. urticae* compared to the tested pyrethroids (fenvalerate and deltamethrin) and organophosphorus (Actellic). Derballa (1999) indicated that dicofol, fenpyroximate and bromopropylate were the most toxic pesticides. Propargite and cypermethrin were of a moderate acaricidal effect. The tested fungicides bupirimate and benomyl were the least toxic pesticides to adult female mites. Also it was found that fenpyroximate, bromopropylate, dicofol and cypermethrin were the most toxic pesticides to the eggs of spider mites *T. urticae*.

The egg stage of spider mite in its different ages always is preferable to the different moving stages (larvae, deutonymph and adult) on different plant leaves. These stages are of different responses to chemicals. So, the testing of selected chemicals against different mite stages may indicate the most efficient compound against mite stages in the field.

The present study was carried out to investigate the toxic effect of some compounds of different chemical groups against different ages of

eggs (one, two, three and four days old eggs) and larval, deutonymphal and adult stages of the mite *T. urticae*.

MATERIALS AND METHODS

Culture Technique:

Mite culture

Culture of two-spotted spider mite, *Tetranychus urticae* (Koch) was reared according to Dittrich (1962).

Chemicals used:

The following pesticides were tested against the two-spotted spider mite stages through this study:

Neoron (isopropyl 4,4- dibromobenzilate) 50% E.C.; Chlorfenapyr [4- bromo-2- (4-chlorophenyl)-1- (ethoxymethyl) –5- (trifluoro-methyl) pyrrole-3- carbonitrile] 36% S.C.; pegasus [(3-(2,6-diisopropyl-4- phenoxyphenyl)-1- tertbutyl- thiourea] 50% WP;Dicofol [1,1-bis (4-chlorophenyl)- 2,2,2-trichloroethanol] 18.5% E.C.; Dicofol-M [(is a mixture of dicofol with mite pheromone namely (sterrup M)] 18.5% E.C.; Fenazaquin [4(2-(4- (1,1-dimethylethyl) phenyl) ethoxy) quinazoline (CA) 4- tert-butylphenethyl quinazolin-4-yl ether] 20% S.C.; Meothrin [-α-cyano-3- phenoxybenzyl 2,2,3,3- tetramethyl cyclopropanecarboxylate] 20% E.C.; Fenpyroximate (tert-butyl (E) -4- [(1,3- dimethyl-5- phenoxypyraz methylen aminooxymethyl) benzoate] 5% S.C.; Nomite [trans-5- (4- chlorophenyl) –N- cyclo-hexyl-4- methyl-2- oxothiazolidine- 3- carboxamide] 10% W.P.; Selecron [0- (4-bromo-2-chlorophenyl) 0- ethyl-5- propyl phosphorothioat] 72% E.C.; propargite [2- (4- (1,1- dimethylethyl) phenoxyl) cyclohexyl sulfite] 72% E.C. and vertimec (abamectin).

Laboratory Experiments:

1-Experiments on the adult female stage:

The direct spraying technique was used to evaluate the toxicity of tested pesticides against the adult female stage according to the method of Mailoux and Morrison (1962).

2- Experiments on egg stages:

The effectiveness of the tested pesticides on eggs of different ages was examined, using the method of Staal *et al.* (1975).

3- Experiments on larvae and Deutonymph Stage:

This test was carried out according to the method of Sekulic (1995).

The results of the experiments under laboratory condition were subjected to statistical analysis to evaluate the relative efficiency of the tested pesticides against eggs, larvae, deutonymph and adult stages. Abbot`s formula (1925) was used to get corrections for natural mortality. The toxicity regression lines were statistically analyzed according to the method described by Finney (1971). The relative efficiency of the tested pesticides was determined according to Sun (1950).

RESULTS AND DISCUSSION

(A) Ovicidal action of tested pesticides against eggs in different embryonic developmental stages of *T. urticae*:-

1- Toxicity to one-day old eggs:

Results in Table (1) show that fenpyroximate was the most effective ovicide against one-day old eggs while diafenthiuron was the least toxic one based on the LC_{50} value. Based on the toxicity index at LC_{50} level (table 1), fenpyroximate was the most potent pesticide (toxicity index =100) and diafenthiuron was the least one (1.52). The slope values of the

toxicity lines of the tested toxicants ranged between 3.983 (diafenthiuron) and 1.167 (fenpropathrin), and the rest toxicants lie between the two values.

2- Toxicity to the two-days old eggs:

Data summarized in Table (1) show that fenpyroximate was also the most potent ovicide against the two days old eggs and diafenthiuron was the least toxic one at LC_{50} level. Concerning the toxicity index (Table 1), fenpyroximate was the most potent ovicide and the rest toxicants were 71.26 to 1.19% as toxic as fenpyroximate at LC_{50} level.

3- Toxicity to the three-days old eggs:

Fenpyroximate showed the highest ovicidal effect on the three days old eggs at LC_{50} 1.59 (Table 1) while diafenthiuron (138.3) was the least one.

Regarding the toxicity index at LC_{50} level, the data indicated that fenpyroximate (100%) was the most potent ovicide and diafenthiuron (1.15) was the least effective one. Concerning the slope values, Table (1), diafenthiuron had the steepest toxicity line (3.607), whereas fenazaquin had the flattest one (1.129). The other compounds came between these two values (2.37 to 1.161).

4- Toxicity to four-days old eggs:

Fenpyroximate was the most potent compound against four days-old eggs at LC_{50} level, and diafenthiuron was the least effective one.

The toxicity index, at LC_{50} of fenpyroximate and diafenthiuron was 100 and 0.87 respectively. Table (1) show also that diafenthiuron had the highest slope value (3.873) while fenpyroximate had the lowest slope one (1.067).

Discussing the present results (Table 1), it could be noticed that the fenpyroximate and hexythiazox were very highly toxic compounds to mite eggs at all tested ages. Similarly the chlorinated hydrocarbon compounds, dicofol, dicofol-M were highly toxic against all egg ages,

while the synthetic pyrethroide fenpropathrin acted as moderate ovicides. The ovicidal activity of the tested O.P. compound profenofos was lower than that of synthetic pyrethroids. The insect Growth Regulator fenpyroximate had the highest ovicidal activity because it may be interfered with the embryonic development steps. These results agree with those obtained by Abd El-Rahman (1975); Mohamed *et al.* (1977); Moussa (1979); Abd El- Rahman (1980) and Yousri (1987). Abd El-Rahman (1975) indicated that the chlorinated hydrocarbon acaricides were in general more toxic to the eggs of *T. arabicus* than the O. P. compounds. Mohamed *et al.* (1977) stated that kelthane and proclonol were more toxic than all tested acaricides on the eggs of *T. arabicus.* Moussa (1979) mentioned that dicofol was the most effective compound, whereas the tested O.P. compounds had poor toxicity against the egg stage of *T. urticae.* Abd El- Rahman (1980) and Yousri (1987) reported that synthetic pyrethroids had only moderate activity against eggs of the mite *T. urticae.*

The comparative susceptibility of the four ages of *T.urticae* eggs to the tested posticide clearly vary during developmental steps. The susceptibility of eggs differed according to their age, and the tested pesticide. The susceptibility of eggs to all compounds was increased as the age of egg increased.

Similar findings were achieved by Smith and Wagenknecht (1959); Smith and Salked (1966); Klein-Koch (1976) and Abd El-Rahman (1975). Smith and Wagenknecht (1959) reported that O.P. compounds inhibited AChE in late stages of embryonic development. Smith and Salked (1966) reported that the effect of an insecticide on mite eggs may vary according to the age of eggs. Klein-Koch (1976) stated that JHAZR- 856 was effective against early embryonic stage only. Abd El-Rahman (1980) mentioned that the toxicity of deltamethrin was increased with the increase of the age of eggs of mite *T. urticae.*

Table (1): Toxicity of tested pesticides against 1, 2, 3 and 4 days – old eggs of T. urticae.

Pesticides	Age of eggs												Total degrees of efficiency
	1 day			2 days			3 days			4 days			
	Leso mg/L	Slope	Toxicity index	Leso mg/L	Slope	Toxicity index	Leso mg/L	Slope	Toxicity index	Leso mg/L	Slope	Toxicity index	
Dicofol	8.330	1.788	30.37	7.146	1.868	25.75	6.474	1.862	24.51	5.742	1.941	19.55	100.18
Dicofol M	6.626	1.702	38.19	6.607	1.808	27.85	5.942	1.945	26.70	5.25	1.913	21.39	114.13
Fenpyroximate	2.530	1.183	100.0	1.84	1.09	100	1.587	1.167	100	1.123	1.067	100.00	400.00
Fenazaguin	6.080	1.539	41.61	4.649	1.27	39.60	3.73	1.129	42.55	3.55	1.319	31.63	155.39
Profenofos	75.350	1.501	3.36	71.6	1.557	2.57	57.78	1.495	2.75	52.00	1.532	2.16	10.84
Chlonfenapyr	6.307	1.345	40.11	5.278	1.344	34.86	4.588	1.379	34.59	4.085	1.404	27.49	137.05
Dafenthiuron	166.700	3.983	1.52	154.59	3.86	1.190	138.3	3.607	1.15	128.8	3.873	0. 87	4.73
Fenpropathrin	9.964	1.167	25.39	4.558	1.207	40.37	3.38	1.299	46.95	3.27	1.282	34.34	147.05
Propargite	90.700	1.869	2.79	77.25	1.737	2.38	64.48	1.706	2.46	57.2	1.633	1.96	9.59
Bromopropylate	4.699	1.321	53.84	6.633	1.329	27.74	5.45	1.161	29.12	6.366	1.574	17.64	128.34
Abamectin	4.104	1.649	61.65	4.391	1.257	41.90	3.69	1.384	43.01	3.097	1.331	36.26	182.82
Hexythiazox	2.704	2.149	93.57	2.582	2.268	71.26	2.468	2.370	64.30	2.38	2.482	47.18	276.31

Table (2): Toxicity of tested pesticides against larval, deutonymphal and adult stages of T. urticae.

Pesticides	Stage of T. urticae									Total degrees of efficiency	Efficiency index	Order
	Larval stage			Deutonymphal stage			Adult stage					
	Lcso mg/L	Slope	Toxicity index	Lcso mg/L	Slope	Toxicity index	Lcso mg/L	Slope	Toxicity index			
Dicofol	2.921	1.393	50.18	4.211	1.401	49.39	4.793	1.427	2.82	102.39	28..9	5
Dicofol M	2.959	1.208	49.54	5.737	1.378	36.25	1.987	2.162	6.79	92.58	29.53	4
Fenpyroximate	1.466	1.73	100	2.08	1.335	100	4.147	1.949	3.26	203.26	86.18	1
Fenazaguin	9.985	1.727	14.68	14.2	1.638	14.65	19.976	2.589	0.68	30.01	26.49	7
Profenofos	17.43	1.05	8.41	11.93	1.00	17.43	6.742	0.924	2.00	27.84	5.53	10
Chlonfenapyr	10.9	1.89	13.45	15.77	0.784	13.19	8.471	1.817	1.59	28.23	23.61	8
Dafenthiuron	47.17	1.76	3.11	58.39	1.82	3.56	72.399	2.008	0.19	6.86	1.66	12
Fenpropathrin	7.23	1.356	20.27	9.07	1.512	22.93	8.944	1.338	1.51	44.71	27.39	6
Propargite	29.66	1.64	4.94	21.34	1.57	9.74	20.288	2.194	0.67	15.35	3.56	11
Bromopropylate	11.07	1.644	13.24	13.57	1.405	15.33	8.802	2.607	1.53	30.1	22.63	9
Abamectin	8.34	1.664	17.58	4.288	1.78	48.5	0.135	1.537	100	166.08	49.84	3
Hexythiazox	3.14	2.261	46.68	3.152	2.069	65.99	2.959	2.138	4.56	117.23	56.22	2

(B) Toxicity of tested pesticides to two chrysalis stages of mite *T.urticae:*

1- Toxicity to larval stage:

From the results shown in Table (2) it could be concluded that fenpyroximate was the most effective compound against larval stage while diafenthiuron had the lowest effect.

Concerning the slope values it was found that profenofos had the steepest toxicity line (slope =1.04) while hexythiazox had the flattest one (slope = 2.261) and the other compounds came between these two values. According to toxicity index, fenpyroximate was the most toxic while diafenthiuron was the least one.

2- Toxicity to deutonymphal stage:

Data summarized in Table (2) showed that fenpyroximate was the most toxic compound against the deutonymphal stage while diafenthiuron was the least one. As regards the slope values, it is clear that hexythiazox (2.069) had the steepest regression line whereas chlorfenapyr (0.784) had the flattest one. The other compounds came in between this range. Concerning the toxicity index data showed that fenpyroximate was the most toxic compound (toxicity index=100) whereas diafenthiuron was (3.59) as toxic as fenpyroximate and the other compounds came between (65.99 to 9.74).

Data in Table (2) indicated that the susceptibility of the immature stages decreased according to the developmental stage. The LC_{50} values of the two immature stages showed that fenpyroximate was the most potent compound LC_{50} value of 1.466 mg/L. for larvae and; 2.08 mg/L. for deutonymph, while diafenthiuron was the least one in effectiveness against the chrysalis stages (the LC_{50} for larval stage was 47.17 mg/L. while for deutonymphal stage was 58.39 mg/L.). This may be due to the variation in the permeability of the cuticle layer, besides the development of the ability of detoxification of the toxicant throughout the various stages of mite maturity.

The data also indicated that fenpyroximate, hexythiazox, dicofol and dicofol-M were the most effective compounds to the two immature stages.

(C) Toxicity of the tested pesticides to adult female stage of the mite *T.urticae*:

Data in Table (2) show that abamectin was the most potent compound against the adult female of the mite *T. urticae* (LC_{50}=0.135), while diafenthiuron (72.399) was the least effective one. The toxicity index for the tested toxicant ranged between 0.19 to 6.79% as toxic as abamectin the most potent compound.

On basis of the slope values, bromopropylate had the steepest toxicity line (shope=2.607), whereas profenofos had the flattest one (slope=0.924).

The present results, indicated that the bacterial filtrate, abamectin had the most toxic effect against the adult female of mite *T. urticae*, whereas the diafenthiuron showed the least effect. The results indicated that the chlorinated hydrocarbons dicofol and dicofol M were effective as adulticides and similar adulticidal activity was observed with hexythiazox and the IGR fenpyroximate. Such activity of the chlorinated hydrocarbons is attributed to the inhibition of the ATPas and then decreased the electron transport when NADH or NADH- linked substrates were used as the electron donors as mentioned by Motoba *et al.* (1992).

The rest tested compounds, i.e, profenofos, chorfenapyr, bromopropylate, fenpropathrin, fenazaquin and propargite were intermediate in their toxicity to adult female stage of the mite *T. urticae*. Such results are in agreement with those obtained by many investigators, Cwillich and Ascher (1961); El-Sebae *et al.* (1978); Moussa (1979) and Penman *et al.* (1981). Cwillich and Ascher (1961) found that the tested O.P. compounds were nearly ineffective against *T. telarius* with the exception of trithon, guthion and phenkapton which showed some toxicity. El-Sebae *et al.* (1978) reviewed that dicofol was more toxic to *T.*

Cinnabarnius than methamidophos (Tamaron) and phosfolan (Cyolane). Moussa (1979) reported that synthetic pyrethroids were intermediate in toxicity to adult female mites *T. urticae*. Penman *et al.* (1981) mentioned that fenvalerate showed significantly faster activity against adult females of *T. urticae* than azinphos-methyl.

(D) Comparative susceptibility of different stages of the two-spotted spider mite *Tetranychus urticae* to the tested pesticides:

Data in Tables (1, 2) showed that:

* The ovicidal activity of tested pesticides clearly differed according to the age and the tested pesticides. Fenpyroximate was the most potent compound for all embryonic developmental stages followed by hexythiazox, bromopropylate whereas diafenthiuron was the lowest potent compound for all stages.

* The toxicity data of tested pesticides against the two chrysalis stages (larvae & deutonymph) showed that the susceptibility decreased according to the developmental stage. At LC_{50} level fenpyroximate was the most potent compound while diafenthiuron was the lowest effective one against the two stages.

* The toxicity data of the tested pesticides against adult female stage indicated that the bacterial filterate abamectin was the most potent compound followed by dicofol M which contains the mite pheromone (Stirrup M) while diafenthiuron was the lowest potent one. Finally the present data indicated that fenpyroximate was the most potent compound against all mite stages except the adult stage, while abamectin was the most effective adulticide , whereas diafenthiuron was the lowest effective compound against all mite stages.

(E) Efficiency of different pesticides on *T. unticae*:

Efficiency of different tested pesticides was calculated in table (2) as efficiency index. All different effects that showed on the red spider

mite may be affected by the chemicals used or their residues, were taken in consideration.

According to this value one can pick the most suitable chemical which can cover all the demands required to minimize the pesticidal hazardous and to maximize the benefit from mite infested crops.

From data in Table (2) it is observed that fenpyroximate is the most efficient compound against all mite stages (efficiency index of 86.18) and has in the same time different effects that enable the compound to contribute in integrated mite management. Hexythiazox comes in the second category (efficiency index of 56.22). Diafenthiuron has an efficiency index of 1.66 which is the lower value between all pesticides tested and this is lead us not to recommend this compound in most of integrated mite management.

No body can say that the efficiency index, the value calculated to pick the most efficient compound is absolutely correct but is relatively the most suitable way to pick the chemical that characterized by different good effects against the red spider mite *T. urticae,* stages.

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الملخص العربى

الحساسية المعملية للأطوار المختلفة للأكاروس ذو البقعتين تتراينكس أورنيكا للمبيدات الأكاروسية

عطية يوسف قريطم
قسم المبيدات-كلية الزراعة بكفر الشيخ-جامعة طنطا

تهدف هذه الدراسة إلى تقييم فاعلية إثنى عشر مركباً كيماوياً من مبيدات الافات على طور البيض في أعمارها المختلفة وكذلك ضد الأطوار المتحركة (اليرقة- الحورية- الحيوان الكامل) وذلك لإختيار المركبات الأكثر كفاءة على جميع الأطوار وإستخدام هذه المركبات في الحقل في عمليات المكافحة.

وقد أوضحت نتائج هذه الدراسة ما يلي:

١- تم إختبار المركبات السابقة على أطوار البيض المختلفة وثبت أن المركب فينبيروكسيمات من أكثر المركبات فاعلية بينما كان مركب الدايافنثيورون أقل المركبات تأثيراً. وقد بينت النتائج إختلاف حساسية طور البيض طبقاً لإختلاف أعمارها حيث تزيد حساسية طور البيض للمبيدات المختلفة مع تقدم عمر البيض من يوم إلى يومين ثم إلى ثلاث وأربع أيام.

٢- درست فاعلية المركبات على طورى اليرقة والحورية الثانية وأثبت أيضاً مركب الفنبيروكسيمات تأثيراً كبيراً على هذين الطورين كما تقدم مركب الديكوفول والديكوفول- إم في ترتيب الفاعلية وإثبتا كفاءة عالية بالمقارنة ببقى المركبات، بينما كان مركب الدايافنثيورون أقل المركبات تأثيراً ضد طورى اليرقة والحورية الثانية.

٣- درست فاعلية المركبات تحت الإختبار على طور الإنثى الكاملة وحقق المركب أبامكتين نتيجة ممتازة وكان أعلى المركبات المختبرة فاعلية وكان مركب الدايافنثيورون أقل المركبات تأثيراً على طول الخط وعلى كل الأطوار المختبرة.

وبناءاً على فهرس الكفاءة لتقدير كافة التأثيرات الخاصـــة بالســـمية علـــى الأكاروس، كان مركب فينبيروكسيمات أكثر المركبات مناسبة وكفاءة على كـــل الأطوار المختبرة مجتمعة، ويمكن إستخدامه فى برامج المكافحة المتكاملة وأقلهم هو مركب الدايافنثيورون على كل الأطوار المختبرة جميعاً.