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FUNGICIDAL AND ACARICIDAL ACTIVITY OF SOME PESTICIDES AGAINST *Alterenaria solani* and *Tetranychus urticae*

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ABSTRACT

The present study was carried out to investigate the toxic effect of the following seven pesticides: benomyl, bupirimate, cypermethrin, dicofol, fenpyroximate, bromopropylate and propargite under laboratory conditions against the adult and egg stages of the two-spotted spider mite *T. urticae*. The fungicidal effect against *A. solani* under laboratory conditions of these pesticides was also evaluated. The results achieved can be summarized as follows: Dicofol, fenpyroximate and bromopropylate were the most toxic acaricides, while propargite and cypermethrin were of moderate toxic effect. The tested fungicides bupirimate and benomyl were the least toxic to adult female mites. On the other hand , Fenpyroximate, bromopropylate, dicofol and cypermethrin were the most toxic to eggs of spider mites *T. urticae*. Dicofol was the most toxic compound against *A. solani* followed by fenpyroximate and bupirimate.

INTRODUCTION

The two-spotted spider mite *Tetranychus urticae* is considered as one of the major pests attacking different agricultural crops such as field

crops, vegetables, fruits and ornamental plants. The infestation by mites caused a great damage to these infested plants followed by a secondary infestation by various pathogens such as virus, bacteria and fungi. The latter organism, i.e., fungi caused serious problems in the field of agriculture.

Different pesticides are used as specific compounds against either mites and fungi. However Interrelationship in the effectiveness of both types of pesticides, i.e., acaricides and fungicides was noticed. So, the acaricidal activity of fungicides as well as the fungicidal activity of acaricides attracted the investigators to be studied, this may be of great benefit in the field of integrated control of either mites or fungi. Zien et.al., (1987) indicated that the results of laboratory studies showed that dicofol was more effective than other tested compounds against mites, *T. cinnabarinus.* Ky and Shepherd (1988) found that the most effective pesticides in controlling the tomato rust mite were dicofol, flubenzimine, cyhexatin, azocyclotin, sulprofos and monocrotophos. Estrada Cotero and Sanchez-Galvesy (1990) determined the toxicity of the acaricides omethoate, oxydemeton-methyl, ethion, chlorobenzylate, propargite, endosulfan, dicofol and phosalone to adult females *T. urticae* with Lc50 values of : 3109.72, 11552.66, 5830.94, 430.19, 1464.18, 13180.91, 2804.25 and 87582.87 p.p.m. respectively. Decraecke and sterk (1992) found that fenpyroximate showed excellent activity at low rates on the phytophagous mites *(T. urticae* and *P. ulmi)* , while Veire et al., (1992) found it of excellent control to *T. urticae.*

Gamieh and Saadon (1998) indicated that vertimec was the most toxic compound, of Lc_{50} 0.12 p.p.m. on the two-spotted spider mite *T. urticae.* Biomite was the inferior toxicant, of Lc50 1005 p.p.m. Egg viability was adversely affected by all compounds (Neron, Sanmite, Ortus, Vertimic and Biomite), however, vertimec was more harmful compared with the other compounds in this respect. Hosny *et al.* (1998) found that Kelthane and tedion were the most toxic compounds against adult females of *T. urticae.*

The present study was carried out to investigate the toxic effect of different pesticides against the egg and adult female stages of the two-spotted spider mite *T. urticae* (Koch). Besides the fungicidal activity of these pesticides on *Alternaria solani* which cause, early blight disease of tomatoes and potatoes, will be evaluated. The investigated pesticides were found sometimes to be active against spider mites and against fungi in some othertimes. The fungi problems specially in plastic green houses is known to be of greet importance due to the suitable conditions of temperature and humidity. So the idea to protect the plants against the two pests, fungi and spider mites by the same compound was thought to be of importance in IPM programms.

MATERIALS AND METHODS

Culture techniques:

1-prey cultures:

Adult female of red spider mites *Tetranychus urticae* (Koch) were collected from stock cultures and allowed to oviposit overnight onto French bean leaves. The females were then removed, and the leaves covered with eggs were placed on clean plants bearing eggs laid within a 24 hour period were transferred to small cages.

After 16 days, ovipositional adult females of uniform age were collected from the culture for experimental use. Fresh plants were placed in the cages when necessary. The prey cultures were kept at 25± 2c° under a 16 hours photoperiod to encourage plant growth, and 60-70 % R.H. The provision of a 16 hours day length also ensured that the mites would not enter diapause.

2-Fungi cultures:

The fungi used in this study (*Alternaria solani*) that cause early blight disease in potatoes and tomatoes was isolated from tomato leaves and reared on potato Dextrose Agar medium (PDA).

Pieces of leaves infected with the fungi were taken off and the surface was sterilized in 0.1 % mercuric chloride for 1 min. This was followed by several rinses in sterile distilled water and plotted between two sterilized filter papers. Surface sterilized plant pieces were aseptically transferred to potato dextrose agar medium (PDA) plats, that were incubated at 28±1C°for 4-7 days and examined daily for the occurrence of fungous growth. The growing fungi were examined microscopically and purified using the hyphal tip technique and kept on PDA slants. Pathogenic isolates were identified according to their cultural and microscopical characters (Barneltt and Hunter, 1972). Slants were maintained at 4 C° for further experiments.

3-Preparation of inoculum.

Isolated fungi were individually grown on PDA in petri dishes for 14 days and incubated at 28 C°. The resultant fungal growth was blended with suitable amount of distilled sterile water for two minutes. Resultant suspensions were filtered through two layers of sterile cloth. Mycelial fragments were counted using petri plates under binocular and was adjusted to 105 fragment/ ml, according to the method of Shahin and Shepared (1979).

4-Pathogenicity test.

The method used was adapted by EL-Helaly *et al.* (1971). The aereal vegetable growth of tested tomato plants was cleaned throughly either by rubbing gently with a piece of cotton soaked in 70% ethyl alcohol and washed with tap water for 15 minutes Foliage inoculation was made by spraying with an inoculum suspensions by means of hand atomizer. Five plants of tested tomato were used in the inoculation test. The inoculated plants were covered with polyethylene bags for 24-48 hours and kept at 24-28c° for 2 to 5 days until disease symptoms developed. Ten weeks old tomato plants, grown individually in pots (15 cm in diameter) were used through out the course of this work for

inoculation proposes. Tomato plants were sprayed daily with water to attain high level humidity. Developed symptoms of the concerned disease was visually observed.

Chemicals used:

The following seven compounds were used:
Dicofol [2,2,2, trichloro –1,1- bis (4- chlorophenyl) ethanol], 18.5% E.C.; Cypermethrin [(RS) -α- cyano-3- phenoxybenzyl (IRS,3RS ; IRS , 3RS)-3- (2,2-dishlorovinyl)-2,2- dimrthylcyclo- propane carboxylate] 25% E.C.; propargite [2-{4-(1,1 dimethylethyl) phenoxyl}cyclohexyl 2-propynylsulfite] 73% E.G.; Fenpyroximate [tert – butyl (E) -∝- (1,3 dimethyl -5- phenoxy pyrazol -4- yl methylene -amino- oxy) =p-toluate] 5% E.C.; Bromobropylate [isopropyl 4,4- dibromobinxilate] 50% E.C.; Bupirimate [5-butyl-2- ethylamino -6- methyl- pyrimidin -4-yl dimethylsulfamate] 25% E.C. and Benomyl [methyl 1- (butyl carbamoyl) benzimidazol-2- yl carbamate] 50% w.p.

Experimental technique:

Leaf discs:

French bean leaf discs were cut using cork borer. So that they were bisected by the midrib, and placed lower surface upper moist on water soaked cotton wool bads in petri dishes. The size of the disc varied depending on the nature of the experiment.

To measure the toxic effect of tested pesticides to the adult female mites, *T. urticae*, all compounds were evaluated by the leaf disc dip tecknique according to Seigler (1947).

The same technique was used to measure toxicity of the egg stage of two-spotted spider mite *T. urticae*.

The Fungicidal activity was measured using redial growth technique according to Targason (1969) and Nene (1971).

The percent inhibition (I%) in the hyphal growth was calculated according to Topps and Win formula (1957) as follows:
Percent Inhibition (I%) = (A-B) / A x 100

Where: A = diameter of untreated hyphal growth.

B = diameter of treated hyphal growth.

I = percent inhibition.

Toxicity index of tested pesticides was determined according to Sun (1950).

RESULTS AND DISCUSSION

1-Toxicity of tested pesticides to adult females of the two-spotted spider mite *T. urticae.*

Seven pesticides, two fungicides (benomyl and bupirimate), one pyrethroid (cypermethrin), one chlorinated hydrocarbon (dicofol), three different chemicals (fenpyroximate, bromopropylate and propargite) were tested for thier toxicity to adult stage of laboratory strain of the two-spotted spider mite*T.urticae* (koch).All tested pesticides were prepared in concentrations as parts per million (p.p.m.) of active ingredient. The mortality was corrected according to Abbott's formula (1925), and it was plotted on a log concentration-probit paper and probit regression lines was statistically analyzed according to Finney (1952).This supplied information on confidence limits of LC_{50} and slope values.

Based on LC_{50} values (table 1) the data indicated that dicofol was the most toxic compound followed by fenpyroximate and bromopropylate to adult females of *T.urticae,* while propargite and cypermethrin have a moderate toxicity. Benomyl,bupirimate were the least toxic on adult females of *T.urticae.* Slope values of the log-concentration-probit lines showed in table (1) indicated that benomyl has the highest slope value, while propargite has the lowest one.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. In other words the highest slope value means more homogeneity in reaction or response of the organism towards the pesticide and in the same time the pesticide is acting as a selection factor

producing an organism strain as pure genetically as possible, while the low slope values indicated heterogeneous mite population, in its response to the chemical.

Concerning the toxicity index at LC_{50} level the data in table (1) confirmed that, dicofol was the most toxic compound on adult females of the spider mite of toxicity index (100) , while propargite and cypermethrin had a moderate toxic effect on adult females of spider mite of toxicity index . Benomyl and bupirimate were the least toxic compounds on adult females of spider mite.

The experiment on adult females spider mite was carried out not only to pick the most toxic compound , but also to record continuous variations in the reaction of different chemicals towards the main pest belonging to phytophagous Tetranychidae.

Table (1): Toxicity of different acaricides and fungicides on adult females of the two-spotted spider mite *(T.urticae)*.

Pesticides	LC_{50}	(C.L) 99%		Toxicity Index	Slope Value
	p.p.m	Lower	Upper		
Dicofol	37	23.56	50.46	100	1.7
Fenpyroximate	43.24	19.50	67.71	85.56	1.03
Bromopropylate	43.47	19.50	67.71	85.11	1.41
Propargite	60.75	37.76	109.78	60.90	0.96
Cypermethrin	74.19	32.47	110.48	49.87	1.25
Benomyl	811.22	659.13	1019	4.56	2.17
Bupirimate	1272.55	879.18	3015.62	2.90	1.27

Dicofol, the chlorinated hydrocarbon acaricide proved to be efficient against this pest in spite of its continuous use in different areas all over the world, and now it is still an important pesticide in many integrated management programes to control Tetranychid mite .

Dicofol was found effective against *T.urticae* by many investigators. (in laboratory by Buergo *et al* . 1986, in the field by Jacob *et al.* 1972 ; and Mamaladze, 1978; Abo Elamayem, 1975; Singh *et al.* 1981; Nassar *et al.*1982; Chapman and Penman,1985; Gough and Qayyum, 1987; and Yigit and Erkilic, 1992).This compound was also found to specifically successful in controlling *T.urticae* resulting from resistance to acaricides Galetenko *et al* .(1979) and Park *et al* . (1986).

The two fungicides, benomyl and bupirimate , were the least toxic compounds tested against the adults of *T.urticae*. Benomyl (Benlate) was used by many researchers against mites as a major pest in green houses besides the fungal diseases, and was found to be effective on *T.urticae* (Tarasova, 1974; Rishi and Rather,1983). These two compounds are of fungicidal nature and they have been used for a long time especially under plastic green houses that have mite pests. So resistant populations of spider mite may be expected.

Fenpyroximate and bromopropylate were of equal toxicity to the adults of *T.urticae*. Schiffauer and Mizell, (1989) observed low susceptibility of *T.urticae* to bromopropylate while Veire *et al.* (1992) found that fenpyroximate gave an excellent control of *T.urticae* in glass house and laboratory experiments, the last finding was again ascertained by Decraecke and Sterk, (1992) who found this compound was of an excellent activity at low rates on the phytophagous mites.

Propargite (Omite) in the present study occupied a moderate position in toxicity against adult *T.urticae* proved to be much effective against adults of *T.urticae* (Singh *et al.* 1981 and Keena and Granett, 1985).

Cypermethrin was moderately toxic against the spider mite. Hurkova, (1984) found that cypermethrin was one of the pyerthorids tested against *T.urticae* that caused knockdown effect in treated females

and the higher concentration (0.1%) was of repellent effect, whereas Kovach and Gorsuch, (1986) indicated that this compound (3 g. a.i) caused the highest mortality of *T.urticae*.

2-Toxicity of tested pesticides on eggs of the two-spotted spider mite *T. urticae* koch.

The same pesticides were tested for their toxicity to one day old-egg of the two-spotted spider mite *T.urticae* koch under laboratory conditions. The toxicity of different tested acaricides on mite eggs and the ovicidal activity of two tested fungicides on the egg stage of the same mite is presented in table (2).The data indicated that fenpyroximate, bromopropylate, were the most toxic compounds against the egg stage of spider mite. Dicofol and cypermethrin were of moderate effect. Then come propargite (an acaricide) and benomyl (a fungicide) in a category of least effective compounds on the egg stage. Concerning the toxicity index at LC_{50} level, the data in table (2) confirmed that, fenpyroximate was the most toxic to eggs of the two-spotted spider mite of toxicity index (100) followed by bromopropylate. While dicofol and cypermethrin were of moderate effect on mite eggs. Bupirimate ,propargite and benomyl were the least toxic on eggs of spider mite of toxicity index (15.09 , 9.81 and 9.18 ,respectively). Many investigators studied the toxicity of different pesticides against eggs of phytophagous mite. Spadafora and Lindquis, (1972) found that spray application of 0.03% benomyl as a systemic fungicide to leaf discs of lima bean in laboratory tests, reduced the percentage hatch of eggs of *T.urticae* (koch). Garica-Mari *et al.*,1983) evaluate the toxicity of dicofol to eggs of *T.urticae*. The toxicity to eggs and larave were similar causing 100% mortality at 200 p.p.m. Nakayama *et al.* (1986) examined the effect of acaricide sprays for control of eggs, nymphs and adults of *T.urticae* koch.

The results showed that bromopropylate plus tetradifon (375and 125ga,i/h) were effective up to 7 days after spraying to eggs. Mizukoshi, (1988) found that the eggs of *T.urticae* collected from apple orchards in Hokkaido were resistant to dicofol.

Table (2): Toxicity of different acaricides and fungicides to eggs of two-spotted spider mite (*T.urticae*).

Pesticides	LC_{50}	(C.L) 99%		Toxicity Index	Slope Value
	p.p.m	Lower	Upper		
Dicofol	16.40	14	20.33	36.46	1.21
Fenpyroximate	5.98	5.29	6.75	100	1.91
Bromopropylate	7.13	5.95	8.59	83.87	1.26
Propargite	60.93	54.21	67.04	9.81	3.03
Cypermethrin	16.58	11.92	21.22	36.06	1.28
Benomyl	65.09	50.13	81.98	9.18	1.33
Bupirimate	39.61	32.62	49.07	15.09	1.59

From the pest management point of view it is not necessary to pick the most effective chemical on mite eggs. It is very important to allow for healthy eggs to hatch to complete life cycle. This contributes, to a large extent, in the reduction of spider mite by allowing the spread of predaceous mites that depend on all developmental stages of spider mite for food consumption. So the LC-p lines of the effect of different chemicals were carried out just to define the pesticides position in the long chain of chemicals that have a role in integrated pest management programmes. It is of interest to note that dicofol known to be of good effect as an adulticide while as an ovicide became a second category after fenpyroximate and bromopropylate. Also propargite has the same effect as an ovicide as the fungicide benomyl.

3-Evaluation of fungicidal activity of different tested acaricides and fungicides on fungus *A.solani*.

Recently, the main attention has been given to study the control of the early blight disease caused by *A.solani* as this disease cause heavy

losses of vegetable crops espicially tomatoes and potatoes during the winter and latter during the summer. This experiment is to investigate the fungicidal activity of different tested pesticides on *A.solani*. Evaluation of fungicidal activity of different tested acaricides on fungus *A.solani* was recorded in table (3).The same activity was evaluated for two fungicides Benomyl and bupirimate. The data show that dicofol was very toxic against the fungus *A. soloni,* followed by fenpyroximate, bupirimate, while cypermethrin and bromopropylate have a moderate toxic effect against this fungus. Benomyl proved to be the least toxic effect against the tested fungus.

The toxicity index depending on IC_{50} values of different pesticides on *A.solani* (Keissler) is shown in the same table (3). Dicofol was the highest toxic compound of toxicity index (100), followed by fenpyroximate, and benomyl in the least.

Table (3): Evaluation of fungicidal activity of different acaricides and fungicides on fungus (*A.solani*)

Pesticides	IC_{50}	C.L.99%		Toxicity Index	Slope Value
	p.p.m	Lower	Upper		
Dicofol	27.33	9.78	49.75	100	0.69
Fenpyroximate	27.67	4.69	56.73	98.77	0.68
Bromopropylate	106.29	39.31	223.26	25.71	0.84
Propargite	160	100.70	527.11	17.08	0.93
Cypermethrin	78.01	27.40	145.94	35.03	0.63
Benomyl	302.53	184.99	676.01	9.03	0.84
Bupirimate	41.76	4.42	90.45	65.44	0.78

Different chemical groups of pesticides were applied against various species of fungi by many investigators. Different species of *Alternaria* such as *A.alternata* (Russell and Linda, 1977); *A.dauci*

(Standberg,1988) and *A.solani* (Dahmen and Staub ,1992) were controlled using different chemical pesticides. The present investigation reported that the specific acaricides dicofol, fenpyroximate were very toxic against the fungus *A. alternata,* which may be supported by March, *(1958)* who *indicated that the acaricide Ovex showed fungicidal activity* for powedry mildew on melon. Daoud *et al.* (1990) found that benomyl was the most toxic compound against *Alternaria sp* followed by fluazifop and Decis (deltamethrin). Aveling *et al.* (1993) found that benomyl did not eradicate *A. porri* on *onion seeds.*

As noted before, the mite management program recommends reduction of the use specific acaricides , to reduce rate of resistance to acaricides in the spider mite.

This would lead us to pick the pesticides which could be used for dual purpose to control spider mite, and the associated fungi also, with low effect to predatory mites. So we can decrease pesticides hazardous by using certain pesticides effective to more than one pest in the same time less effective to natural enimies.

It is observed that bromopropylate is the most efficient compound while benomyl is the least efficient one, other compounds could be arranged as fenpyroximate > dicofol > bupirimate > cypermethrin > propargite against the two-spotted spider mite *T. urticae* and *A. solani* fungi.

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الملخص العربى

النشاط الإبادى الفطرى والأكاروسى لبعض المبيدات ضدفطر الألترناريا سولانى والأكاروس تترانيكس أورتيكا

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قسم المبيدات-كلية الزراعة بكفر الشيخ-جامعة طنطا

وجهت الدراسة الحالية لبحث التأثير السام لبعض المبيدات الكيماوية وهى مبيدات أكاروسية متخصصة (الديكوفول- البروبرجيت- الفينبيروكسميت- البروموبروبيليت) وكذلك بعض المركبات غير المتخصصة وهى السيبرمثرين واثنان من المبيدات الفطرية (البيوبريميت- البينوميل) ضد الإناث البالغة للأكاروس الاحمر ذو البقعتين تترانيكس أورتيكا، ولاختبار التأثير الإبادى لهذه المبيدات على طور البيض أيضا.

كما اختبر تأثير المبيدات على احد الفطريات للمجموع الخضرى وهو الألترناريا سولانى حيث يصيب عديد من المحاصيل وخاصة بعد اصابتها بهذا الاكاروس حيث يوجد مصاحبا للاكاروس على هذه المحاصيل بعد أصابتها بالأكاروس وخاصة فى الصوب الزجاجية وذلك للخروج بالمركبات الاكثر سمية على الاكاروس مما يسمح باستخدامها فى برامج المكافحة المتكاملة وكذلك لها خواص ابادية لفطريات المجموع الخضرى المصاحبة وخاصة فطر الالترناريا سولانى و بالتالى يكون المركب ذو فائدة مزدوجة و بالتالى ترشيد استخدام المبيدات والحد من التلوث البيئى وفى نفس الوقت نحافظ على التوازن البيئى.

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

١-أظهر الديكوفول والفينبيروكسميت و البروموبروبيليت أعلى سمية على الإناث البالغة للأكاروس الأحمر ذو البقعتين حيث بلغت قيمة LC_{50} (٣٧ ، ٤٣,٢٤ ، ٤٣.٣٧) جزء فى المليون على الترتيب، بينما البروبرجيت والسيبرمثرين كانت لهم سميه متوسطة حيث بلغت قيمة LC_{50} (٦٠,٧٥، ٧٤,١٩) جزء فى المليون على الترتيب. أما البيوبريميت والبينوميل كمبيدات فطرية فقد أظهرا أقل سمية على الاناث البالغة للحلم العنكبوتى حيث بلغت قيمة LC_{50} (٨١١,٢٢، ١٢٧٢,٥٥) جزء فى المليون على الترتيب.

٢-أظهرت المركبات الفينبيروكسميت و البروموبروبيليت والديكوفول و السيبرمثرين أعلى سمية على البيض وكانت قيم LC_{50} لهذه المبيدات هى (٥,٩٨، ٧,١٣، ١٦,٤٠، ١٦,٥٨ جزء فى المليون)على الترتيب. أما البيوبريميت والبروبرجيت والبينوميل

كانت لهم سمية متوسطة على البيض بالمقارنة بالمركبات السابقة حيث كانت قيم LC_{50} لهذه المبيدات هى (٣٩,٦١ ، ٦٠,٩٣ ، ٦٥,٠٩جزء فى المليون) على الترتيب.
أظهر الديكوفول أعلى سمية ضد فطر الالترناريا سولانى حيث كانت قيمة IC_{50} ٢٧,٣٢جزء فى المليون يلية الفينبيروكسميت والبيوبريميت حيث كانت قيمة IC_{50} (٢٧,٦٧ ، ٤١,٧٦ جزء فى المليون) على الترتيب بينما السوبرمثرين والبروموبروبيليت كان لهما سمية متوسطة على الفطر حيث كانت قيم IC_{50} (٧٨,٠١، ١٠٦,٢٩ جزء فى المليون) على الترتيب يليهما البروبرجيت حيث كانت قيمة IC_{50} (١٦٠جزء فى المليون). أما البينوميل فكان أقل المركبات سمية ضد فطر الالترناريا حيث كانت قيمة IC_{50}(٣٠٢,٥٣جزء فى المليون).