ESTIMATION OF GENERAL SELECTIVE TOXICITY RATIOS OF CERTAIN ACARICIDES TO *STETHORUS GILVIFRONS* (MULSANT) AND ITS PREY *TETRANYCHUS URTICAE* KOCH

EL-ADEWY A.M[1], H. YOUSRI[1], Y.M. AHMED[2], K.TIILIKKALA[3], AND T.A. EL-SHARKAWY[4]

1 Plant Protection Research Institute, Ismailia Agricultural Research Station.

2 Plant Protection Department, Faculty of Agriculture, Suez Canal University.

3 Agricultural Research Centre of Finland, 31600 Jokioinen, Finland.

4 Plant Pathology Research Institute, Agricultural Research Centre, (Under Secretary of State for plant quarantine, Ministry of Agriculture, Dokki, Egypt.

(Manuscript received 15 March, 1999)

Abstract

The general selective toxicity ratio of twelve acaricides to avoid the confusion result from the use of two selective ratios, at LC_{50} and LC_{90} levels, was determined. The relative toxicity of the tested compounds against *S.gilvifrons* and its prey *T.urticae*, revealed that dicofol was the most effective compound, whereas fenpyroximate was the least effective against the mite at each of LC_{50} and LC_{90} leels. Results also showed that fenpropathrin had the highest toxicity, at the same former levels, while propargite (Comite) had the lowest toxicity at LC_{50} level and propargite (Acargite) at LC_{90} level against S.gilvifrons. The value of the general selective toxicity ratio recommended fenazaquin, propargite (Acargite), azocyclotion, dicofol, ethion, propargite (Comite), bromopropylate, hexythiazox, profenofos and fenpyroximate as the safest acaricides for *S.gilvifrons* as compared to its prey *T.urticae*.

Key words: selective, acaricides, *Stethorus gilvifrons*, *Tetranychus urticae*.

INTRODUCTION

The two spotted spider mite is a common herbivores on numerous crops and has the potential to cause serious damage. Biological control is believed to be able to suppress mite population and delay the population growth. *Stethorus gilvifrons* is a predacious coccinellid especially effective against tetranychid mites (Pavlouva 1975). The two spotted spider mite is the most abundant prey species available to this predator in Ismailia governorate (Ahmed 1988). Although the use of biological control has largely eliminated the need for chemical control of the two spotted spider mite, pesticides

were occasionally needed to prevent spider mite from causing economic injury when predators alone were not sufficiently effective. The selective chemicals are not available and outbreaks of mites are caused by reduction in their natural enemies when pesticides are used to control pests. Under integrated pest management program high population of pest not adequately suppressed by their natural enemies (Prokopy *et al.* 1990). Our main goal is to estimate the quantitative acute toxicity for certain acaricides against the predator *S.gilvifrons* and its prey *T.urticae* and to recommend the least toxic acaricides against the predator as a general selective toxicity ratio to control the mite through I.P.M program.

MATERIALS AND METHODS

The strain of the two spotted spider mite *T.urticae* was reared at Ismailia Agriculture Research Station on sweet potato leaves according to the method of Nassar (1974). The strain was kept in cheese cloth cage 60 x 60 x 60 cm. away from pesticides contamination under laboratory condition (25 ± 2^{O}C temperature, 65 ± 5% relative humidity and 12 hrs daily illumination by using fluorescent tubes of 40 watt) for 9 months. The strain of the predator, *Stethorus gilvifrons,* was reared at Ismailia Agricultural Research Station on sweet potato leaves heavily infested with the mite *T.urticae* as a sufficient food supply in glass tube (5 cm) covered with muslin following the methods of Sarhan *et al.* (1989).

Acaricides : The tested acaricides were selected to include the main chemical groups of pesticides, as follows:

- **Acargite** 57 EC (propargite) 2-(4-tert-butylphenoxy) cyclohexylprop-2-ynyl sulfite.

- **Ac, 303,603** 36 Sc (pirate) 4-bromo-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethymal) pyrrole-3-carbonitrile.

- **Comite** 73 EC (propargite) 2-(4-tertbutylphenoxy) cyclohexylprop-2-ynyl sulfite.

- **Kelthane** 18.5 EC (dicofol)1,1-bis (4-chlorophenyl -2-2-2 trichlorothanol.

- **Ethitox** 50 EC (ethion) (0,0,0,0-tetraethyl s,s methylene-bis-phosphorodithioate.

- **Meothrin** 20 EC (fenpropathrin) (α-cyano-3-phenoxybenzyl-2,2,3,3-tetramethyl cyclopropane-1-carboxlate.

- **Neoron** 50 EC (bromopropylate) isopropyl 4, 4-dibromobenzilate.

- **NNI-850** 5SC (fenpyroximate) tert-butyl (E) -4- (1,3-dimethyl-5-phenoxypyrazol-4yl) methyleneamino oxy p-toluate.

- **Nonmite** 10 WP (hexythiazox) trans-5-(4-chlorophenyl)-N-cyclohexyl-4-methyl-2-oxothiazolidine-3-carboxamide.

- **Peropal** 25 WP (azocyclotin) 1-(tricyclohexyl stannyl)-1-H-1,2,4-triazole (C.A.).

- **Pride** 20 EC (fenazaquin) 4-tert-butylphenethyl quinazolin-4-yl ether.

- **Selecron** 72 EC (profenofos) o-(2-chloro-4-bromo-phenyl)-o-ethyl-s-n-propylphosphorothioate.

Leaf disk method was used to test compounds against the adult females mite. Sweet potato leaf discs (1 inch in diameter) dipped in the toxicat solution for five seconds, then left to dry. Twenty adult females were transferred to each disc by the aid of fine brush. The discs were placed in petri-dishes lined with water-saturated cotton wool. Each petri-dish contained 4 discs and each disk represented a replicate. The same method was to test the acaricides against the adult stage of the predator. Sweet potato leaves were dipped in toxicant solution for five seconds and were left to dry. Fifty moving instars of the mite and twenty adult predators were transferred on each treated leaf, placed in glass tubes (5 cm) covered with muslin. Five concentrations of each acaricide were used to establish the toxicity line. The treatment were kept under constant conditions of $25^{o}C \pm 2$, $65 \pm 5\%$ relative humidity. The mortality counts were estimated after 24 hours of treatments. The criterion for mortality was the failure of prey or predator adult to respond positively by leg movement following ligh, or prodding with a fine disc.

Abbot's formula (1925) was used to get corrections for natural mortality and the toxicity lines were statistically analyzed according to the method described by Finney (1952). To calculate general selective toxicity ratio, steps suggested by Abd El-Aal *et al.* (1979) were used with a slight modification as follows:

The linear equation of Finney is

$$Y = a + b \log x \qquad (1)$$

where Y = probit mortality and x = concentration.

From the above equation, LC_{90} and LC_{50} can be related:

$$6.28 = a+b \log LC_{90} \quad (2)$$

$$5.00 = a+b \log LC_{50} \quad (3)$$

where 6.28 and 5.00 are the probit mortality of 90 and 50%, respectively. By subtracting equation (3) from equation (2) and taking the antilogarithm, equation (4) is obtained:

$$LC_{90} = LC_{50} \times 10^{1.28/b}$$

Assuming that two species, *T.urticae* (T) and *S.gilvifrons* (S) are to be compared at the LC_{90}, the following equation results:

$$LC_{90}(T)/LC_{90}(S) = LC_{50}(T)*10^{1.28/b(T)}/LC_{50}(S)*10^{1.28/b(S)} \quad (5)$$

$$\text{or } LC_{90}(T)/LC_{90}(S) = LC_{50}(T)/LC_{50}(S)\ 10^{1.28/b(T)-1.28/b(S)} \quad (6)$$

The selectivity ratio (s.r) at the LC_{90} level can then be related to that of the LC50 level as follows:

$$\text{Calculated s.r. } LC_{90} = (\text{experimental s.r. } LC_{50})*10^{\ 1.28[b(S)-b(T)b(S)} \quad (7)$$

RESULTS

The efficiency of the tested compounds was evaluated against the adult stage of the two spotted spider mite. Results in table 1 show that dicofol was the most potent compound at each of LC_{50} and LC_{90} levels. At LC_{50} level, dicofol was followed descendingly by bromopropylate, propargite (Comite), propargite (Acargite), profenofos, azocyclotin, ethion, fenpropathrin, pirate, fenazaquin, hexythiazox and fenpyroximate. The lowest value of LC50 was for dicofol (2.45 ppm) and the highest value was for fenpyroximate (40 ppm). At LC90 level, dicofol followed descendingly by profenofos, azocyclotin, propargite (Acargite), ethion, bromopropylate, propargite (Comite), fenpropathrin, fenazaquin, pirate, hexythiazox and Fenpyroximate. The lowest value of LC90 was for dicofol (13.68 ppm) and the highest value was for fenpyroximate (203.89). The variation in the order of the tested compounds between LC90 level due to the variation in the slope values. The results in table 1 showed that ethion had the steepest toxicity line (3.1), whereas propargite (Comite) had the flattest one (1.22). Concerning the efficiency of the tested compounds on the adult stage of the predator *S.gilvifrons*, the results in table 1 show that the most effective compound at LC_{50} level was fenpropathrin (11.02 ppm), whereas the least effective one was propargite (Co-

mite) (217.25 ppm). The LC_{50} level of the other compounds came in between. The descending order was ethion (13.69), profenofos, (16.46), pirate (18.17), azocyclotin (25.08), fenazaquin (114.95), and propargite (Acargite) (149.6) ppm. It is clear that at the LC_{90} level, fenpropathrin was also the most potent acaricide (52.43ppm) and the least toxic acaricide was fenazaquin (8376.78 ppm). The rest of toxicants lie between the values of the aforementioned two compounds, in the following descending order of toxicity; pirate (61.1), profenofos (92.24), azocyclotin (142.89), fenpyroximate (378.77), bromopropylate (571.16), dicofol (623.00), ethion (936.33), propargite (Comite) (1372.46), hexythiazox (1634.56), and propargite (Acargite) (1778.28)ppm. As regards the slope values, results in table 1 show that pirate had the steepest toxicity line (2.43), whereas fenazaquin that the flattest one (0.52). The selective toxicity ratio is also listed in table 1. The least toxic ratio was found for dicofol (0.02) and highest ratio showed by fenpropathrin (1.68). The descending order of the ratios pirate (1.02), ethion (0.92), fenazaquin (0.79), profenofos (0.65), fenpyroximate (0.52) azocyclotin (0.45), hexythiazox (0.26), bromopropylate (0.08), propargite-Acargite-(0.06) and propargite-Comite-(0.03).

Concerning the selective ratio at LC90 level, pirate had the highest ratio (1.84), whereas fenazaquin had the lowest one (0.01). The descending order of the remaining ratios was fenpropathrin (1.64), fenpyroximate (0.54), profenofos (0.30), azocyclotin (0.22), haxythiazox (0.08), bromopropylate (0.07), propargite (Comite) (0.06), ethion (0.04), and dicofol & propargite (Acargite) (0.02). Based on the mentioned results in table 1, compounds could be categorized against the adult females of mite, to highly toxic acaricides (dicofol, bromopropylate, propargite-Comite and propargite-Acargite), toxic acaricides include profenofos, azocyclotin, ethion, pirate and fenpropathrin and low toxic compounds that include the tested compounds.

Concerning the toxicity of the tested compounds against the predator *S. gilvifrons* (coccinelidae), it is clear from table 1 that fenpropathrin, ethion, profenofos and fenazaquin had moderate toxicity. Fenpyroximate and brompylate showed low toxic activity, whereas dicofol, hexythiazox and propargite-(Acargite & Comite) revealed a weak toxicity against the predator.

As regards the selectivity ratio, table 1 show that dicofol had the lowest selective toxicity ratio, whereas fenpropathrin had the highest one at LC_{50} level and the rest of the tested compounds lie between the two extremes. However, at LC_{90} level fenazaquin had the lowest ratio, while pirate had the highest one. Owing to the non-consistency in the order of the tested compounds based on the selectivity ratio at the

two level LC_{50} and LC_{90} two selectivity ratios are not aduate to decide which compound is considered safe for natural enemies under application.

DISCUSSION

The general selective ratio resulting from combining the two levels LC_{50} and LC_{90} is probably more proper. Data presented in table 1 show that fenazaquin had the lowest general selectivity ratio (0.01) and fenpropathrin had the highest (3.13). Based on the general selectivity ratio, it is obvious that fenazaquin, propargite (Acargite), azocyclotin, dicofol, ethion, propargite (Comite), bromopropylate, hexythiazox, profenofos and fenpyroximate can be considered as the safest on the predator *S.gilvifrons* and simultaneously effective against its prey *T.urticae*. Other acaricides cause more damage to the predator. This result device us to use the safer group of acaricide to *S.gilvifrons* as a biocontrol agent.

Results are in agreement with those obtained by Shoukry *et al.* (1989) who found that dicofol had high effect against the adult stage followed by profenofos, whereas the synthetic pyrethriodes were moderate in their toxicity.

Broadley (1983),who mentioned that the pyrethroid compounds, cypermethrin and deltamethrin have high toxic activity against *Coccinella repanda* (Coccinilledae).

ACKNOWLEDGMENT

We would like to thank every body in the EFARP Project for their help. Support of the Egypt-Finland Agric. Res. Project No 142001 03-7 is gratefully acknowledgment.

Table 1. Toxicity of certain acaricides to the two spotted spider mite *T.urticae* and *S.gilvifrons*.

No	Compound	*T.urticae*			*S.gilvifrons*			Selectivity ratio at level		General selectivity ratio*
		LC_{50}	LC_{90}	Slope b(T)	LC_{50}	LC_{90}	Slope b(T)	LC_{50}	LC_{90}	
1	Brompropylate	6.24	37.35	1.66	77.96	571.16	1.48	0.08	0.07	0.06
2	Azocyclotin	11.19	32.03	2.8	25.08	142.89	2.00	0.45	0.22	0.03
3	Dicofol	2.45	13.68	1.25	110	623.00	1.7	0.02	0.02	0.04
4	Ethion	12.78	33.06	3.1	13.89	936.33	0.7	0.92	0.04	0.04
5	Fenazaquin	22.73	111	1.85	28.94	8376.78	0.52	0.79	0.01	0.01
6	Fenpropathrin	18.48	88.75	1.35	11.02	52.43	1.89	1.68	1.69	3.13
7	Fenpyroximate	40.0	203.89	1.81	77.0	378.77	1.48	0.52	0.54	0.36
8	Hexythiazox	19.85	130.32	2.0	114.95	1634.56	1.11	0.26	0.08	0.08
9	Pirate	18.57	112.2	1.64	18.17	61.1	2.43	1.02	1.84	1.83
10	Profenofos	10.7	27.94	3.07	16.46	92.24	1.71	0.65	0.30	0.3
11	Propargite (Acargite)	8.66	32.8	2.24	149.6	1778.28	1.2	0.06	0.02	0.02
12	Propargite (Comite)	6.86	76.78	1.22	217.52	1372.46	1.6	0.03	0.06	0.05

* values greater than 1 indicate unsafe to the predator

REFERENCES

1. Abbot, W.S. 1925. A method of effectiveness of an insecticide. J. Econ. Entomol., 18: 265-267.

2. Abdel-Aal, Y.A.I, A.M.K., El-Sayed A.A Negm M.H. Hossein and A.H.El-Sebae. 1979. The relative toxicity of certain insecticides to *spodoptera littoralis* (Boisd). and *Coccinella undecimpunctata* L. International Pest Control, July/August,, 79: 82.

3. Ahmed, S.A. 1988. Studies on the biological control of two spotted spider mite in Suez Canal area (M.Sc. thesis Fac. Agr. Suez Canal Univ.)

4. Broadely, R.M. 1983. Toxicity of insecticides to *Coccinella repanda* Thunberge and *Harmonia octomaculatua* (Fabricius) (Coleoptera: Coccinellidae) [potential predators of *Heliothis* spp.] Queensland-Journal of Agricultural and Animal Sciences (Australia). 40 (2):125-127.

5. Finney, D.J. 1952. Probit analysis-a statistical treatment of the sigmoid response curve. Cambtridge University Press. (C.F. M. Sc. Thesis Sherif R.M. Zagazig 1978).

6. Nassar, M.E. 1974. Factors involved in developing resistance in spider mites. Ph.D. Thesis, Fac. of Agric., Ain Shams University.

7. Pavlova-G.A. 1975. *Stethorus*-predator of the spider mite. Zashchita Restenii, 1: 23-24.

8. Prokopy, R.J., S.A. Johnson and M.T. O'Brien1990. Second-stage-integrated managment of apple arthropod pests. Entomol. Exp. Appl. 54: 9-19.

9. Sarhan A.A., A. Shoukry and A.A. Sayed 1989. Biological studies on *Stethorus gilivi-forns* (Mulsant). Predator of *Tetranychus urticae* (Kock) in Egypt. 3rd Nat. Con. of Pests & Dis. of Veg.& Fruit in Egypt and Arab Countries. Ismailia, Egypt. 1:124-139.

10. Shoukry .A., Y.M.Ahmed A.M.A Mostafa and A.M.M. El-Adawy1989. Suseptibility of different devlopment stages of spider mite *Tetranychus urticae* koch to certain pesticides. 3rd Nat. Conf. of pests & Dis of Veg. & Fruits in Egypt and Arab count. Ismailia, Egypt. 1:408-421.

تقدير نسبة عامه للسميه الاختيارية لمبيدات أكاروسيه معينه ضد المفترس *Stethorus gilvifrons* والفريسه *Tetranychus urticae*

عبد الله محمد مرسى العدوى[١] - حسين يسرى[١] - يسرى محمد أحمد[٢]
كارى تيليكالا [٣] - طه الشرقاوى[٤]

١ معهد بحوث وقاية *النباتات* - مركز *البحوث الزراعية* - *الجيزه*،
٢ قسم وقاية *النبات* - *كلية الزراعة* - جامعة *قناة السويس*،
٣ مركز *البحوث الزراعية* - *فنلندا*،
٤ معهد بحوث *أمرض النبات* - مركز *البحوث الزراعية* - *الجيزة* .

تم تقدير نسبة عامه للسميه الاختياريه لمبيدات أكاروسيه معينه والتى تتجنب حدوث اضطراب فى استخدام هذه المركبات نتيجة وجود نسبتين للسميه الاختيارية أحداهما عند مستوى التركيز القاتل لـ ٥٠٪ والاخرى عند مستوى التركيز القاتل لـ ٩٠٪. تم اختيار السميه النسبيه لعدد ١٢ مركب أكاروسى ضد كل من الحلم العنكبوتى والمفترس . أوضحت النتائج المتحصل عليها أن الديكوفول هو اكثر المركبات المختبره سميه على العنكبوت ، بينما كان الفنبير وكسيمات أقلها سميه عند المستويين LC_{50} LC_{90}. كان الفتبروباثرين أكثر المركبات المختبره سميه ضد المفترس عند نفس المستويين السابقين وكان بروبارجيت (كوميت) أقلها سميه عند مستوى LC_{50} بينما كان بروبارجيت (أكارجيت) عند مستوى LC_{90} . أوضحت القيم الاختيارية للمبيدات الاكاروسية المختبره أن المركبات فينزاكين - بروبارجيت (أكارجيت)-ازوسيكلوتين - ديكوفول - أثيون - بروبار جيت (كوميت)- بروميبروبيلات - هكساثيوزوكس - بروفينفوس وفنبير وكسيمات أكثر أمانا على المفترس مقارنة بتأثيرها على الحلم العنكبوتى .