MOLLUSCICIDAL EFFECTS OF SOME CHEMICAL COMPOUNDS AGAINST *MONACHA CARTUSIANA*(Muller) AND *EOBANIA VERMICULATA* (Muller) LAND SNAILS UNDER LABORATORY AND FIELD CONDITIONS

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Abstract

This study investigated the toxic action of three chemical insecticides, neomyl 90% WP , solfac 50% EC and sumithion 50% EC were applied as poison baits against two species of deleterious land snails, adults (*Monacha cartusiana* and, *Eobania vermiculata*) under laboratory and field conditions.

The tested insecticides were selected from three different chemical groups, carbamates, pyrithroides and organophosphates successively.

The obtained results revealed that, the three insecticides revealed obvious molluscicidal activity against the tested snails, recording 96-h/LC50.

Neomyl was the most effective one, there was no survivals at highest concentrations after 24-hours post-treatment.

According to LC50, LC90, Toxicity index and Relative potency at the two levels, the descending order of the tested insecticides was, neomyl, solfac and sumithion.

M. cartusiana snails were more affected by the tested insecticides than *E.vermiculata* under field conditions.

According to the obtained results , it can be recommended by using these insecticides as molluscicides among the integrated pest management (IPM) programs.

INTRODUCTION

During the last few years land snails are becoming serious pest in Egypt (Ismail and Shetaia , 2009). These animals attack almost all crops reducing their yields , their marketing values and cause severe damages to all plant parts (El- Okda, 1980) as a result of the mucous secretion and the particular structure of their mouth parts enabling scratching and crushing. In addition, some of these animals work as intermediate hosts for parasite trematodes, cestodes and nematodes which cause worm diseases in man and domestic animals.Therefore, they attack the attention of the biologists because of the great economic damage they do in agriculture and horticulture (Godan, 1983).

Recently, many efforts have been directed towards snail screening and evaluation the molluscicidal activity of various chemicals with different methods. These methods include toxicity tests, pharmacological and physiological mood of

action indicating the sensitivity of various land snail species towards different pesticides. For example, activity of inorganic salts, mesurol, abamictin, aldicarb, methomyl, lindan, sevin, and dipterex was already tested against land snails, now these molluscicides became the common means of snail's control (Ismail and Hegab, 2006) .

The present research investigated if land snails, *M. cartusiana* and *E. vermiculata* can successfully respond to neomyl, solfac and sumithion as molluscicides? through recording the mortality percentages under laboratory conditions for 21 days and estimating the values of LC50, LC90, toxicity index and relative potency at the two levels and estimation the reduction percentages of population density under field conditions.

MATERIALS AND METHODS

1- Experimental animals

Adult specimens of the herbivorous snails (*Monacha cartusiana* and *Eobania vermiculata*) were collected during March 2010 from untreated fields of Sharkia Governorate, clover fields at Zawar Abou El – Layl village for *Monacha cartusiana* and ornamentals nursery at Zigzag city for *Eobania vermiculata*. Samples were transported in porous plastic bags to the laboratory, fed on clean wheat bran bait for two weeks for acclimatization (El – Okda, 1981).

2- Tested insecticides

A – Neomyl 90% WP :

Chemical group : carbamates

Trade name : Neomyl 90% WP

Common name : Methomyl

B- Solfac 50% EC :

Chemical group : Synthetic pyrethroids

Trade name : Solfac 50% EC

Common name: Cyfluthrin

C – Sumithion 50% EC :

Chemical group : organophosphates

Trade name : Sumithion 50% EC

Common name : Fenitrothion phosphorothioate.

These chemicals were obtained from Plant Protection Research Institute , Agricultural Research Centre , Dokky, Giza – Egypt.

3- Laboratory experiments

The three tested insecticides were prepared as poison baits by mixing the calculated weight or volume of the insecticide with wetted bran to give the concentrations (0.031, 0.0625 , 0.125 , 0.25 , 0.5 and 1) % of neomyl and (0.125, 0.25, 0.5, 1, 2, 4, 8) % of solfac or sumithion . Neomyl baits including an active ingredient (281, 563, 1125, 2250, 4500, 9000) ppm respectively. Solfac or sumithion baits have an active ingredient (625, 1250, 2500, 5000,10000, 20000 and 40000) ppm respectively. About 10 grams of the poisonous bait was added into each plastic container (¾ Kg) capacity . Ten healthy adults of *M. cartusiana* or *E. vermiculata* were introduced . Containers were closed with muslin cloth and secured with rubber band to prevent snails from escaping (El- Okda , 1981). Each concentration was replicated four times . control treatment was prepared using bran bait only without any chemicals. Mortality percentages were recorded after 1, 2, 3, 4, 7, 15and 21 days post – treatment . Observation of mortality entailed using stainless steel needle according to El- Okda (1981). Dead snails were removed after testing and mortality percentages were calculated .The data were then analyzed using the Probit analysis (Finney, 1971). The LC50 and LC90 values were estimated for the tested chemicals. The relative efficiency as toxicity index (T.I) was determined by using Sun's equation (1950). Relative potency (R.P) values were measured according to the method described by Zidan and Abdel- Megeed (1988). Analysis of variance was conducted to test significance between treatments and control using F .test and L.S.D. values according to Snedecor (1957). Where :

$$\text{Sun's toxicity index} = \frac{\text{LC50 or LC90 of the standard material}}{\text{LC50 or LC90 of the treated material}} \times 100$$

$$\text{Relative potency} = \frac{\text{LC50 or LC90 of the lowest toxic compound}}{\text{LC50 or LC90 of the most toxic compound}}$$

Field experiment

The field trails were performed at Zawar –Abou –El –Layl village- Awlad Sakr district- Sharkia Governorate, at the area of about one feddan cultivated with Egyptian clover (*Trifolium alexandrium*) heavy infested with the land snails *M. cartusiana* . The field was irrigated only day before any treatment. *E. vermiculata* field trials were applied at heavy infested ornamentals at the beach of mweas sea - Zagazig City.

The tested insecticides were applied with one concentration (2%) by incorporating the tested insecticides with wetted wheat brain and black sugar cane syrup was added as an attractive substance (indicated concentration + 95 parts of bran + 5 parts of sugar cane syrup). About 100 gm of the tested baits were offered on plastic pieces 50x50 cm. Each treatment was replicated four times . Control treatment was designed by the same manner without any chemicals. Alive snails were recorded in check and treatments before and after 1,2, 3, 7, 15 and 21 days post- treatment. Population reduction percentages were calculated according to Henderson and Tillton equation (1955) as follows :

% Reduction = 100 [1 – t2 r1/t1r2] where :

r1and r2 are the number of alive snails before and after treatment respectively in untreated plots (control) , t1 and t2 are the number of alive snails before and after treatment respectively in treated plots .

Data were subjected to statistical analysis and treatment means were compared by L.S.D test according to Little and Hills (1978).

RESULTS AND DISCUSSION

A- Laboratory experiment

Mortality perentages of *M. cartusiana* adults fed on toxic baits of the tested insecticides was shown in Table (1). It can be seen that neomyl was the most effective one. At highest concentration (9000) ppm , there was no survivals after 24 hours post–treatment. After seven days ,mortality perentages were, 55, 38.33 and 48.33 at neomyl, solfac and sumithion successively. Statistical analysis revealed that there were significant differences between the treated and untreated *M. cartusiana.* The differences between the tested insecticides were nonsignificant.

Data in Table (2) illustrated that neomyl was more toxic than sumithion and solfac against *E. vermiculata.* At highest concentration, there was no survivals where mortality percentage was 100. The mean values of mortality percentages after seven days post-treatment were, 88.33, 80 and 56.66 with neomyl, solfac and sumithion consecutively. Analysis of variance revealed high significant differences between the treated and untreated *E.vermiculata* . The difference between mortality percentages at neomyl and solfac was insignificant. Mortality percentages at sumithion significantly varied with that at neomyl and solfac.

At the lowest concentrations , the tested chemicals failed to affect on *M. cartusiana* and *E. vermiculata.*

Data in Table (3) revealed the toxic effect of the three tested insecticides against *M. cartusiana* and *E. vermiculata.* Based on LC50 and LC90 values, neomyl

was the most potent against both species recording the lowest values, 1568 and 7765ppm against *M. cartusiana*. The corresponding values against *E. vermiculata* were, 3723 and 15820. Sumithion was the least effective showing LC50 and LC90 values, 12063 and 37028 ppm respectively against *M. cartusiana*. The corresponding values against *E. vermiculata* were, 7358 and 151552 ppm. Solfac had the intermediat values of LC50 and LC90 (11763 and 33447) ppm against *M. cartusiana* . The corresponding values against *E. vermiculata* were, 4412 and 21487 ppm. The slop values revealed that the tested insecticides had the descending order, neomyl ,solfac and sumithion (4.75, 4.4 and 4.1) respectively for *M. cartusiana*. The corresponding values for *E. vermiculata* were (3.43, 2.29 and 1.25).

As shown in Table (3), toxicity index at LC50 and LC90 proved that neomyl was taken as the standard molluscicid and gave the arbitrary index value of 100 unites.. Toxicity index at LC50 and LC90 were, (100 and 100), (13.33 and23.22) and (12.99 and 20.97) of neomyl, solfac and sumithion successively against *M. cartusiana*. The corresponding values for *E. vermiculata* were, 100 and 100, 84.09 and 73.6 and 50.6 and 10.4 .

Respecting the relative potency, neomyl was the standard recording the highest toxic potency against the two species followed by solfac and sumithion. At LC50 and LC90 levels, values were (7.69 and 4.77), (1.03 and 1.11) and (1 and 1) for neomyl, solfac and sumithion consecutively against *M. cartusiana*. The corresponding values for *E. vermiculata* were, (1.98 and 9.6), (1.66 and 7.05) and (1 and 1).

B-Field experiment

(Table 4) indicated that the same trend was nearly observed when the tested insecticides were applied under field conditions. The popupation reduction percentages of *M.cartusiana* and *E.vermiculata* treated with neomyl, solfac and sumithion increased gradually with time of exposure till the seventh day, then decreased . Neomyl exhibited higher molluscicidal efficiency than solfac and sumithion. After 7- days post-treatment, the reduction percentages were, 91.6, 88.8 and 80 of *M.cartusiana* treated with neomyl, solfac and sumithion consecutively. The corresponding values of *E. vermiculata* were, 90, 76.6 and 68.3. ANOVA- test showed nonsignificant difference between values of the reduction percentages of *M.cartusiana* at the three tested insecticides. For *E.vermiculata, the difference was* significant between neomyl and sumithion.

Our results are in agreement with that reported by El - Okda *et al.*, 1989 on carbamates. Also our results agree with Radwan and El- Wakil, (1991) on carbamates and synthetic pyrethroids and confirmed with the findings of Hegab (2003) who found that a carbamate compound induced highest population

reduction percentage of the brown garden snail *E. vermiculata* . Aioub *et al.* (2002) found that the carbamate compounds appeared to be the most toxic in comparison with organophosphorous and herbicides against both *M. cartusiana* and *E. vermiculata.*

Bailey (2002) said that the carbamate are feeding inhibitors leading to death. Godan, (1983) said that the increasing of the mucous secretion is one of the first reaction of gastropods to many stressors including mechanical irritation caused by molluscicidal chemical leading to death.

Fortunately, some carbamate and synthetic pyrethroid insecticides are widely used to control insects and may be sprayed at seasonal activity of snails. These compounds seem to affect the terrestrial snail *E. vermiculata* and *M. cartusiana* by contact or stomach poisoning and may affect on other species as well. This may help to diminish the need of specific molluscicides in the field area and decrease the environmental pollution and total cost of pest control programs (Radwan and El- Wakil , 1991). Finally, in our study , successive control was carried out with neomyl, solfac and sumithion which are recommended to be promising in controlling the terrestrial snail *M. cartusiana* and *E. vermiculata.*

Table 1. Mortality percentages of Monacha cartusiana adults fed on poison baits of different insecticides for 21 days under laboratory conditions.

Insecticide	Conc.ppm(a.i.)	% Mortality after (days)							
		1	2	3	4	7	Mean	15	21
Neomyl	281	0	0	0	0	0	55a	0	0
	563	10	20	20	30	30		40	60
	1125	10	20	20	30	50		70	70
	2250	20	20	20	30	50		70	70
	4500	80	80	90	90	90		100	100
	9000	100	100	100	100	100		100	100
Solfac	625	0	0	0	0	0	38.3ab	0	0
	1250	0	0	0	0	0		0	40
	2500	0	0	0	0	0		20	40
	5000	0	0	10	20	20		20	50
	10000	0	0	20	30	30		30	50
	20000	0	30	20	80	80		90	100
	40000	0	40	70	100	100		100	100
Sumithion	625	0	0	0	0	0	48.3a	0	0
	1250	0	0	0	0	10		30	70
	2500	0	0	20	20	20		30	90
	5000	0	0	20	20	50		70	90
	10000	0	0	20	30	50		80	100
	20000	10	0	30	80	60		80	100
	40000	10	30	70	90	100		100	100
Control	0	0	0	0	0	0	0b	0	0
F. test							*		
L.S.D.							38.95		

Table 2. Mortality percentages of Eobania vermiculata adults fed on poison baits of different insecticides for 21 days under laboratory conditions.

Insecticide	Conc.ppm(a.i)	% Mortality after (days)							
		1	2	3	4	7	Mean	15	21
Neomyl	1125	0	0	0	0	0	88.3a	0	0
	2250	0	0	0	60	60		60	80
	4500	20	30	40	60	80		90	90
	9000	30	40	60	80	90		100	100
	18000	60	90	90	90	100		100	100
	36000	70	100	100	100	100		100	100
	72000	100	100	100	100	100		100	100
Solfac	625	0	0	0	0	0	80a	0	0
	1250	0	0	0	40	70		100	80
	2500	10	30	50	60	70		90	90
	5000	10	40	50	60	70		80	90
	10000	10	50	50	70	80		80	90
	20000	40	60	70	90	90		70	100
	40000	40	70	80	100	100		0	100
Sumithion	625	0	0	0	0	0	56.7b	0	0
	1250	0	0	10	20	30		40	60
	2500	0	0	20	40	40		40	80
	5000	0	0	20	40	40		40	80
	10000	0	10	20	50	50		80	80
	20000	0	10	30	70	80		80	100
	40000	0	30	70	100	100		100	100
Control	0	0	0	0	0	0	0c	0	0
F. test							* *		
L.S.D.							20.54		

Table 3. Toxicity of the three insecticides used as poison baits against adults of Monacha cartusiana (Muller) and Eobania vermiculata (Muller).

Insecticid	*Monacha cartusiana*							*Eobania vermiculata*						
	LC50 ppm	LC90 ppm	Slope	Toxicity index at		Relative potency At		LC50 ppm	LC90 ppm	Slope	Toxicity index at		Relative potency at	
				LC50	LC90	LC50	LC90				LC50	LC90	LC50	LC90
Neomyl	1568	7765	4.8	100	100	8	4.8	3723	15820	3.4	100	100	2	9.6
Solfac	11763	33447	4.9	13.3	23	1.03	1.11	4412	21487	2.3	84	74	1.7	7
Sumithion	12063	37028	4.1	12.9	21	1	1	7358	151552	1.3	51	10	1	1

Table 4. Population reduction percentages of Monacha cartusiana (Muller) at the concentration 2 % of the tested pesticides as poisonous baits under field conditions.

Insecticid	% population reduction after									
	1 day		3 days		7 days		15 days		21 days	
	M.c	*E.v*	*M.c*	*E.v*	*M.c*	*E.v*	*M.c*	*E.v*	*M.c*	*E.v*
Neomyl	78.0	60	91.6	86.6	91.6	90.0 a	76.4	71.6	20.0	16.6
Solfac	67.4	38.3	70.8	60.0	88.8	76.6ab	68.5	61.6	13.0	10.0
Sumithion	59.7	0.0	65.7	20.0	80.0	68.3 b	58.0	41.6	10.4	5.00
					N.S	*				
L.S.D 0.05					15.38	14.55				

M.c= Monacha cartusiana

E.v= Eobania vermiculata

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التاثير الابادى لبعض المركبات الكيميائية ضد قواقع *Monacha cartusiana* , *Eobania vermiculata* الأرضية تحت الظروف المعملية والحقلية

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معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – الجيزة

تمت دراسة تاثير ثلاثة من المبيدات الحشرية الكيميائية وهى نيوميل (مسحوق قابل للبلل) – سولفاك (مستحلب) – سومثيون (مستحلب). والتى استخدمت كطعوم سامة ضد نوعين من القواقع الارضية الضارة وهما قوقع البرسيم الزجاجى (*Monacha cartusiana*) اليافع وقوقع الحدائق البنى الكبير (*Eobania vermiculata*) اليافع وذلك تحت الظروف المعملية والحقلية.

وقد اختيرت المبيدات المختبرة من ثلاث مجموعات كيميائية مختلفة هى على التوالى– الكربامات– البيريثرويدات – الفوسفورية العضوية.

وقد أوضحت النتائج ما يلى :

١– اظهرت المبيدات الحشرية المختبرة نشاط ابادى واضح ضد كلا النوعين من القواقع مسجلة التركيز القاتل لنصف تعداد القواقع المعاملة وذلك خلال ٩٦ساعة فقط من المعاملة وقد تزايدت النسبة المئوية للموت بزيادة قيمة التركيز و فترة التعرض.

٢– كان النيوميل اشد المبيدات كفائة حيث بلغت النسبة المئوية للموت اقصاها (١٠٠%) عند التركيزات العالية بعد ٢٤ ساعة فقط من المعاملة.

٣– كان الترتيب التنازلى للمبيدات الحشرية المختبرة هو على التوالى : نيوميل – سولفاك- سومثيون وذلك طبقا لقيم LC50 وLC90 و دليل السمية والكفاءة النسبية للمبيد.

٤– كانت قواقع *Monacha cartusiana* اكثر تاثرا بالمبيدات الحشرية المختبرة جميعها مقارنة بقواقع *Eobania vermiculata* وذلك تحت الظروف الحقلية.

فى ضوء النتائج الموضحة فانه يمكن التوصية باستخدام هذة المبيدات الحشرية كمبيدات رخوية وذلك ضمن برامج المكافحة المتكاملة.