CONTROLLING ASPECTS AGAINST TERRESTRIAL SNAILS *EOBANIA VERMICULATA* AND *MONACHA CARTUSIANA* UNDER LABORATORY CONDITIONS

by

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ABSTRACT

Controlling aspects were conducted under laboratory conditions against the brown garden snail, *Eobania vermiculata* Müller and the glassy clover snail, *Monacha cartusiana* Müller during the period from January to March, 2009. First, the influence of carrier and attractive materials in attracting populations of *E. vermiculata* and *M. cartusiana* during February, 2009 was investigated. Wheat bran with sugar-cane syrup recorded the highest percentage in numbers of attracted *E. vermiculata* and *M. cartusina* populations to clumps with 39.47 and 40.57%, respectively after 24 hrs. While, using of wheat bran with dry yeast showed the least percentage of attraction for both snail species in this respect.

Secondly evaluating certain pesticides including oligomer, carbamate and organophosphorous compounds as poisonous baits, using the most effective carrier and attractive materials, against the two snail species during the activity period in March, 2009. The molluscicidal efficiency of the tested pesticides according to mortality percentages after 15 days of treatment for the two snail species could be arranged as follows: profenofos > ethoprofos > metaldehyde > oxamyl and anilofos. On the other hand, toxicity studies for these pesticides revealed that, metaldehyde, profenofos were the most toxic to *E. vermiculata* and *M. cartusiana* with toxicity index of 88.6 , 97.3 and 100.0 , 100.0, respectively. While, anilofos recorded the least toxicity index for *E. vermiculata* and *M. cartusiana* in this respect.

Finally, observations of death symptoms for *E. vermiculata* and *M. cartusiana* poisoned individuals by the most toxic compounds (metaldehyde and profenofos) showed that, snails poisoned with metaldehyde differ markedly from those following profenofos poisoning. For example, the molluscicidal effect of metaldehyde based on causes snails to secrete large amounts of mucus with resulting desiccation leads to death, loss of activity, muscular contraction. Contracted, compact with very hard foot muscles and motionless movements. Snails remain alive for several days, upon metaldehyde intoxication.

In contrast, snails poisoned with profenofos showed continue crawl and mucus secretion body water remain almost normal, they remain active for a while, snails were exited and move with the body longitudinally extended and optic tentacles protruded, foot muscles still expanded and become longer and very soft, movements of snails are gradually inhibited and becomes motionless after longer time than in case of metaldehyde.

Key words : Terrestrial snails, controlling methods, molluscicidal effect, death symptoms, *E. vermiculata* and *M cartusiana*.

INTRODUCTION

Recently, Terrestrial snails have increased greatly in economic importance. They cause great damage to vegetable and filed crops, fruit trees and ornamental plants in Egypt (Kassab & Daoud, 1964 and El-Deeb *et al.*, 1996). In Sharkia Governorate, *Eobania vermiculata* Müller and *Monacha cartusiana* Müller were considered to be the most important snail species. Also, they were known as destructive pests causing damage to economic crops (Arafa, 1997; Ismail, 1997; Hegab *et al.*, 1999; Mahrous *et al.*, 2002; Ismail, 2004 and Abd El-Aal, 2008).

Currently these snail species are controlled chemically by using certain pesticides. This is in agreement with the main aim of the present study for controlling *E. vermiculata* and *M. cartusiana*, under laboratory conditions. Firstly, trying certain substances as attractive materials and others as adjuvants (carriers) to attract snails to clumps as baits during February, 2009 followed by application of certain pesticides as poisonous baits during activity period of the snail species in March, 2009. Finally, description of certain morphological symptoms for poisoned snails with the most effective tested compounds.

MATERIALS AND METHODS

Preparation of tested snail species:

Samples of the brown garden snail, *E. vermiculata* Müller and the glassy clover snail, *M. cartusiana* Müller from navel orange orchard highly infested with mixed populations of the two snail species in Anshas locality, Belbies district, Sharkia Governorate during January, 2009 were collected from untreated orchards in the early morning from plant vegetation and soil surface according to (Awad, 1994). The collected samples were sent to the laboratory in muslin bags provided with some green leaves. Individuals of each species were kept in glass container ($30\times40\times50$ cm^3) contained moist clay soil and closed with muslin cloth. Snails were supplied daily with fresh leaves of cabbage during two weeks for acclimatization. The remaining diet was removed every two days and the walls of terraria were biweekly washed to remove snails wastes and then moistened with water to maintain soil moisture at 75 ± 5 %.

In the present study various controlling aspects have been studied which can be used effectively to diminish population density and consequently damage caused by certain land snail species; *E. vermiculata* and *M. cartusiana*.

Effect of carrier and attractive materials commonly used in poisonous baits:

This experiment was conducted during February, 2009 under laboratory conditions. The tested carrier materials used in baits were; wheat bran, crushed maize, or mixture of 50 : 50 % wheat brane to crushed maize. On the other hand, the evaluated attractants were; boiled potatoes, sugar-cane syrup and dry yeast.

The tested carriers and attractants were applied as mixed baits in clumps, each one consist of 95 parts from one of the tested carrier materials; wheat brane, crushed maize or mixture of 50 : 50 % wheat brane to crushed maize +5 parts from one of the tested attractive materials; boiled potatoes, sugar-cane syrup or dry yeast. Each clump contained 100 gm, separately offered on plastic trays. Baits were separately offered on plastic trays at different triangle directions of one meter distance in (north, east and west) from each 100 snail species located in the middle of these trays. Numbers of attracted snails were counted at each direction using 0.25 m^2 quadrate placed adjacent to the bait after 2 hours of application and then at intervals of 2 hours during the experimental time of 24 hours. Attraction percentages were calculated and the obtained data were statistically analyzed using F test.

Efficiency of certain pesticides:

Pesticides used:

Five pesticides commonly applied against different pests in field and horticulture crops were used in this experiment. Some of these compounds are applied in the soil to control nematodes or weeds the classes of these tested formulations, common name, trade name, formulation type and chemical or scientific name were as follows:

1- Aniloguard (anilofos 50 % EC), Herbicide

S-4-chloro-N-isopropylcarbaniloylmethyl O,O-dimethyl phosphorodithioate

2- Selecron (profenofos 72 % EC), Insecticide

(RS)-(O-4-bromo-2-chlorophenyl·O-ethyl S-propyl phosphorothioate)

3- Metaldehyde (metaldehyde 5 % G), Mollucicide

r-2,c-4,c-6,c-8-tetramethyl-1,3,5,7-tetroxocane

or 2,4,6,8-tetramethyl-1,3,5,7-tetraoxacyclooctane

4- Mocap (ethoprophos 10 % G), Nematocide

O-ethyl S,S-dipropyl phosphorodithioate

5- Vaydate (oxamyl 24 % SL), Nematocide

(EZ)-N,N-dimethyl-2-methyicarbamoyloxyimino -2-(methylthio)acetamide

The tested pesticides were obtained as fresh formulated products from central Agricultural Pesticides Laboratary, Dokki, Giza, Egypt.

Molluscicidal Activity:

Adult snails of *M. cartusiana* (12-13 mm shell diameter) and of *E.vermiculata* (25 mm shell diameter) needed for these experiment were collected. Ten snails of each species were transferred to plastic pots of 10 cm diameter contained ½ kg moist clay soil. Each treatment was replicated 3 times. The tested snails were starved 24 hours before testing and Molluscicidal activity of the compounds were tested during the activity period of snail species in March, 2009. The toxicants were applied as poisonous baits at concentration of 0.40, 0.80, 1.60 and 2.40 % a.i. (parallel parts of toxicant + 5 parts of sugar-cane syrup + 95 parts of wheat brane) for each chemical compound. Control treatment was designed by the same manner without pesticide. Baits were offered on plastic trays inside every pot each one contained about 100 gm. Individuals of each snail species were counted in each pot. Population counts were entailed 24 hours before and after application and then, at intervals of two days during the experimental period of 21 days beginning in 5 March, 2009.

Toxicity of the tested compounds:

1. Mortality percentages in each population of the snail species were calculated and corrected according to the Abbott's formula (1925) as follows:

$$\%\ \text{Mortality} = \frac{\text{mortality \% of treatment} - \text{mortality \% of control}}{100 - \text{mortality \% of the control}} \times 100$$

2. The toxicity lines were statically analyzed according to Litchfield and Wilcoxon (1949) as follow: Y = a + b.x where; Y = probit unit, a = constant value, b = slope of line and x = log concentration.

3. The toxicity index of the tested compounds were determined according to Sun (1950) as follow: Toxicity index = (LC_{50} of the most effective compounds / LC_{50} of the tested compounds X 100).

Death symptoms of the poisoned snail species:

Poisoned snail species with the tested compounds were individually placed in a container with their soft parts, shell carefully washed with fresh water by help of fine teeth brush for removing any thing stocked on the shell and lift to dray, on piece of cotton, then kept in plastic bags provided with the code number; labeled and packed for searching their changes in morphological structure Mann *et al.* (1989). After that, the poisoned snail of each species was photographed and visceral mass of each snail species was described.

RESULTS AND DISCUSSION

Effect of carrier and attractive materials in attracting snail species under laboratory conditions:

The aim of the present study is to select the effective carrier and attractive materials which can increase the attractiveness as well as, the molluscicidal efficiency of pesticides in controlling *E. vermiculata* and *M. cartusiana*. Data presented in Table (1) indicated that, the tested materials gave significant effect on attracting populations where, the clumps introduced to the two species obviously attracted the populations. Since, 24 hours after treatment, the highest percentage of *E. vermiculata* and *M. cartusina* to clumps was noticed when using wheat bran with sugar-cane syrup with recorded values:

39.47 and 40.57 %, respectively. While, the parallel values recorded 34.63 and 33.23 %, when using wheat bran with boiled potatoes, respectively.

On the other hand, using of wheat bran with dry yeast showed the least percentage of attraction for *E. vermiculata* and *M. cartusiana* recording; 25.90 and 27.47 %, respectively. While, using each of crushed maize or mixture of wheat bran and crushed maize with each attractive materials gave moderate effect of attraction ranged between 27.77 to 39.30 %. Generally, it could be concluded that, using certain attractive and carrier materials mixed with each others as baits in controlling methods could showed significant effect in attracting populations of *E. vermiculata* and *M. cartusiana*.

When discussing the foregoing results, it is worthy to mention here that, El-Sebae *et al.* (1982) found, bran baits containing raddish and ragee el-kone gave higher percent mortality to snail than nokhalah and germah. However Stephenson, 1972 also showed the water-soluble protein-rich, constituents of wheat bran are palatable to gastropods and can be used as an arrestant. Godan (1983) mentioned that, molasses and wheat bran were considered the most effective in mixtures with molluscicides. Kassem and Abdallah, 1992 indicated that, attractability of rice bran, saw dust and ground maize were less than wheat bran as carver material in controlling terrestrial gastrotods. Asran (1994) indicated that, bran was the most preferable bait to the garden snail, *Helix aspersa* followed by crushed wheat and crushed maize. On the other hand, she revealed that, sugar-cane syrup proved to be the most attractive additive substance followed by molasses, while vanillia was the lowest attractant in this respect. Finally Mohamed (1994) showed that, sugar-cane syrup and molasses are consider the most promising additives mixed with poisonous baits in controlling of snails and slugs.

Table (1): Influence of carrier and attractive materials in attracting populations of *E. vermiculata* and *M. cartusiana* under laboratory conditions.

Carrier materials	Attractive materials	(%) Attraction after treatment for *E. vermiculata*			General mean
		North	East	West	
Wheat Bran	Boiled potatoes	34.1	32.9	36.9	34.63c
	Sugar-cane syrup	40.6	36.3	41.5	39.47a
	Dry yeast	25.3	30.8	21.6	25.90f
Crushed maize	Boiled potatoes	35.4	33.5	31.1	33.33d
	Sugar-cane syrup	43.5	35.1	38.1	38.90ab
	Dry yeast	21.1	31.4	30.8	27.77e
Wheat bran and crushed maize	Boiled potatoes	33.1	35.9	33.9	34.30cd
	Sugar-cane syrup	36.5	39.4	35.4	37.10b
	Dry yeast	30.4	24.7	30.7	28.60e

Table (1): Continued.

Carrier materials	Attractive materials	(%) Attraction after treatment for *M. cartusiana*			General mean
		North	East	West	
Wheat Bran	Boiled potatoes	33.9	30.9	34.9	33.23c
	Sugar-cane syrup	36.3	40.9	44.5	40.57a
	Dry yeast	28.7	27.9	25.8	27.47e
Crushed maize	Boiled potatoes	34.1	30.4	31.5	32.00cd
	Sugar-cane syrup	34.8	40.9	37.8	37.83b
	Dry yeast	31.1	28.7	30.7	30.17d
Wheat bran and crushed maize	Boiled potatoes	32.9	32.4	30.6	31.97d
	Sugar-cane syrup	37.4	41.2	39.3	39.30a
	Dry yeast	30.8	30.1	24.5	28.47e

Data in the columns followed by the same letter (s) were not significantly differed ($p < 0.05$) according to Duncan's multiple range test.

Efficiency of certain pesticides against *E. vermiculata* and *M. cartusiana* under laboratory conditions:

Data presented in Tables (2 and 3) showed that, the tested pesticides reduced populations of *E. vermiculata* and *M. cartusiana.* Since, 15 days after treatment all pesticides exhibited various degrees of percent snail mortality compared to control. For instances profenofos, ethoprofos showed the highest values of mortality percentages in populations of *E. vermiculata* and *M. cartusiana* with means of 100.0, 93.3 % and 100.0, 100.0 %, respectively. On the other hand, metaldehyde and oxamyl gave moderate effect in decreasing populations recording 90.0 and 88.0 % for *E. vermiculata* and 85.3 and 80.3 % mortality for *M. cartusiana,* respectively.

While, anilofos was the least effective compound with percent mortality of 84.7 and 79.5 % for *E. vermiculata* and *M. cartusiana*, respectively. Generally, the molluscicidal efficiency of the tested pesticides according to general means of mortality percentages after 15 days of treated as poisonous baits for the two snail species could be arranged as follows : profenofos > ethoprofos > metaldehyde > oxamyl and anilofos.

Our results are in accordance with the findings of Fox (1964) who found that, herbicides were effective against land snails and could be persist in the soil or in the plant for considerable time and may even accumulate in gastropods. Also, Godan (1983) mentioned that, using herbicides not only kill weeds but also molluscs either through the animal skin or by ingestion through the intestine. Radwan *et al.* (1992) found that, the bran toxic baits of five oxime carbamate pesticides gave highly toxic effect against *Theba pisana* under laboratory conditions as well as Ismail (1997) assured that, organophosphorous compounds gave highest efficiency in controlling *M. cartusiana* under field conditions. Moreover, Abdallah *et al.* (1998) tested twenty-four compounds belonging to carbamates, organo-phosphates, cholorinated hydrocarbons against *E. vermiculata* and *T. pisana.* They illustrated that; aldicarb, methomyl, monocrotophos and paraquate were the most toxic compounds against both tested snail species. Also, similar results had been recorded by many authors i.e. Lokma and Al-Harpy (1999), Aioub *et al.* (2000), Mahrous *et al.* (2002) and Abd El-Aal (2001 and 2008).

Table (2) : Efficacy of certain pesticides in controlling the brown garden snail, *E. vermiculata* under laboratory conditions at Sharkia Governorate during March, 2009.

Formulations	(%) a.i.	Conc. ppm	(%) Mortality of *E. vermiculata* after treatment (in days)			
			(3)	(7)	(9)	(15)
Metaldehyde 5 % G	0.40	4000	20.0	21.6	26.7	33.3
	0.80	8000	33.3	33.3	40.0	47.7
	1.60	16000	45.0	46.7	46.7	76.3
	2.40	24000	56.8	60.0	66.7	90.0
Oxamyl 24 % SL	0.40	4000	20.0	21.6	26.7	33.3
	0.80	8000	33.3	33.3	40.0	47.7
	1.60	16000	45.0	46.7	46.7	78.3
	2.40	24000	46.7	53.3	60.0	88.0
Profenofos 72 % EC	0.40	4000	20.0	21.6	26.7	33.3
	0.80	8000	66.0	69.8	84.7	91.7
	1.60	16000	78.0	76.5	91.2	100.0
	2.40	24000	88.0	87.3	100.0	100.0
Ethoprophos 10 % G	0.40	4000	20.0	21.6	26.7	33.3
	0.80	8000	40.0	60.0	73.3	80.0
	1.60	16000	64.6	64.6	86.7	93.3
	2.40	24000	81.0	81.0	86.7	93.3
Anilofos 50 % EC	0.40	4000	20.0	21.6	27.7	33.3
	0.80	8000	40.0	50.0	54.3	80.0
	1.60	16000	40.0	53.5	70.7	80.0
	2.40	24000	56.8	60.0	84.7	84.7

Table (3) : Efficacy of certain pesticides in controlling the glass clover snail, *M. cartusiana* under laboratory conditions at Sharkia Governorate during March, 2009.

Formulations	(%) a.i.	Conc. ppm	(%) Mortality of *E. vermiculata* after treatment (in days)			
			(3)	(7)	(9)	(15)
Metaldehyde 5 % G	0.40	4000	20.0	21.6	26.7	33.3
	0.80	8000	40.3	43.3	46.7	60.0
	1.60	16000	40.0	45.0	60.0	73.3
	2.40	24000	41.6	46.7	46.7	85.3
Oxamyl 24 % SL	0.40	4000	20.0	21.6	26.7	33.3
	0.80	8000	26.7	30.0	40.0	40.0
	1.60	16000	26.7	33.5	40.0	65.0
	2.40	24000	41.6	46.7	46.7	80.3
Profenofos 72 % EC	0.40	4000	20.3	20.3	20.0	33.3
	0.80	8000	68.7	72.9	88.3	96.3
	1.60	16000	80.3	80.3	95.0	100.0
	2.40	24000	90.1	90.1	100.0	100.0
Ethoprophos 10 % G	0.40	4000	20.3	20.3	20.0	33.3
	0.80	8000	40.0	56.6	73.3	93.3
	1.60	16000	65.6	80.0	93.3	100.0
	2.40	24000	82.3	86.7	93.3	100.0
Anilofos 50 % EC	0.40	4000	13.3	16.6	20.0	20.0
	0.80	8000	33.3	40.0	40.0	40.0
	1.60	16000	53.3	53.3	69.5	69.5
	2.40	24000	53.3	54.8	79.5	79.5

Toxicity of certain pesticides against *E. vermiculata* and *M. cartusiana* under laboratory conditions:

Three organophosphorous compounds; anilofos, profenofos and ethoprofos, one carbamate; oxamyl and an oligomer; metaldehyde were tested for their toxicity to *E. vermiculata* and *M. cartusiana* under laboratory conditions at Sharkia Governorate. The tested compounds were evaluated for their toxicity after 3 and 15 days post treatment.

Based on values of LC_{50}, data presented in Table (4) showed that, these values after 15 days of treatment with anilofos against *E. vermiculata* and *M. cartusiana* recorded 8000 and 9800 ppm, respectively. While, the parallel values recorded 7400 and 9000 ppm, when using oxamyl, respectively. While, three days after treatment the LC_{50} of the tested pesticides against *E. vermiculata* and *M. cartusiana* differed from pesticide to another.

Table (4): Comparative toxicity of the tested pesticides against the brown garden snail, *E. vermiculata* and the glassy clover snail, *M. cartusiana* under laboratory conditions at Sharkia Governorate during March, 2009.

Formulations	Snail species	LC50 ppm	Confidence limits (CL)		SV	TI*
			Upper	Lower		
After 15 days						
Metaldehyde 5 % G	*E. vermiculata*	7000	10425.7	6153.8	2.30	88.6
	M. cartusiana	6200	8293.6	4769.2	1.99	100.0
Oxamyl 24 % SL	*E. vermiculata*	7400	10832.6	4800.0	2.20	83.8
	M. cartusiana	9000	12439.9	6521.7	1.80	68.9
Anilofos 50 % EC	*E. vermiculata*	8000	10423.3	6153.8	2.20	77.5
	M. cartusiana	9800	12730.8	7538.5	2.30	63.3
After 3 days						
Profenofos 72 % EC	*E. vermiculata*	7400	10435.0	6153.8	2.50	97.3
	M. cartusiana	7200	8887.9	5853.7	2.70	100.0
Ethoprophos 10 % G	*E. vermiculata*	10000	12993.1	7692.8	2.20	72.0
	M. cartusiana	9800	12730.8	7538.5	2.30	73.5

SV = Slope values and TI* = Toxicity index

In this respect, metaldehyde proved to be the most effective compound among all pesticidal treatments recording 7000 and 6200 ppm against *E. vermiculata* and *M. cartusiana*, respectively.

On the other site, it appears that, profenofos has the highest slope value on *E. vermiculata* and *M. cartusiana* recorded 2.50 and 2.70, respectively. In other words, the highest slope value means homogeneity in response of the snail species towards the pesticide and at the same time the pesticide is acting as a selection factor producing on snail species as pure genetically as possible, while the low slope value indicates heterogeneous snails populations. Finally, all the gained data revealed that, metaldehyde, profenofos were the most toxic to *E. vermiculata* and *M. cartusiana* with toxicity index of 88.6, 97.3 and 100.0, 100.0, respectively. While, anilofos recorded the least toxicity index of 77.5 and 63.3 for *E. vermiculata* and *M. cartusiana*, respectively.

Differences in death symptoms of poisoned snail species:

Poisoned individuals of *E. vermiculata* and *M. cartusiana* by the most toxic examined compounds; metaldehyde and profenofos were placed in a container with their soft parts. Certain observations were carefully noticed on their morphological changes. After that, visceral mass of each snail species were photographed and immediately after death was described.

The symptoms shown by poisoned snails with metaldehyde differ markedly from those following carbamate poisoning. For example, Fig.(1-1,3) showed, the molluscicidal effect of metaldehyde which based on its irritant effect, causes snails to secrete large amounts of mucus with resulting desiccation leads to death, the body water lost as a result of excessive mucus production and later loss of activity, the foot muscles is contracted, hard and their shape becomes very compact. The movement of snails was inhibited and becomes motionless, the degree of inhibition and activity as a result of excessive production of mucus differs for different individuals and species. Snails are not usually killed immediately by metaldehyde bait, but remain alive for few days finally paralysis and death.

In contrast, in Fig. (1-2,4) poisoned snails with profenofos showed continue to crawl since, mucus secretion and body water remain almost semi normal, they remain active for a while, snails were exited and move with the body longitudinally extended and optic tentacles protruded. The foot muscles still expanded and become longer and very soft. The movements of snails poisoned by profenofos are gradually inhibited, becomes motionless after longer time than it is in the case of metaldehyde.

When discussing the foregoing results, similar results had been recorded by many authors i.e.; Godan (1983), El-Okda (1985), Bakhtawar and Mahendru (1987), Baker (1989), Coupland (1996) and Barker (2002).

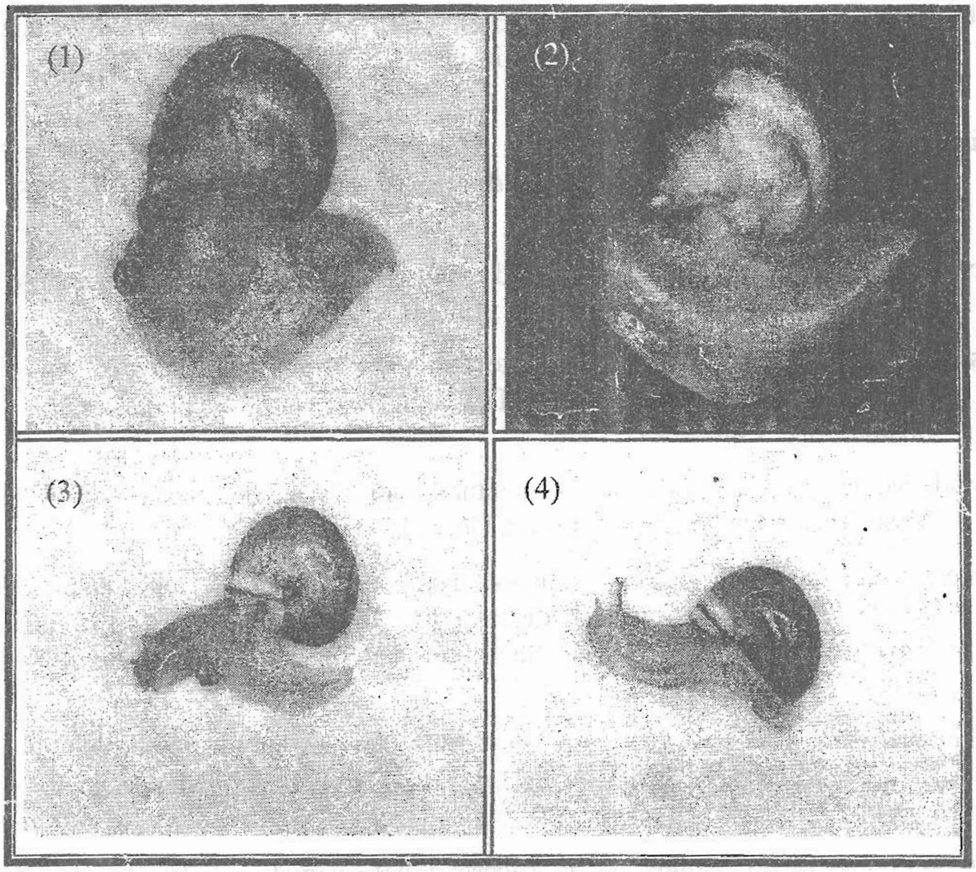

Fig. (1): Death symptoms of *E. vermiculata* (1,2) and *M. cartusiana* (3,4) after treated with metaldehyde (1,3) and profenofos (2,4).

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جوانب من عمليات المكافحة لنوعين من القواقع الأرضية تحت الظروف المعملية

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تم دراسة تاثير بعض المواد الجاذبة والحاملة وكذلك فعالية بعض المبيدات والاعراض الظاهرية للتسمم تحت الظروف المعملية لنوعين من القواقع الأرضية ، قوقع الحدائق البني *Eobania vermiculata* Müller وقوقع البرسيم الزجاجي *Monacha cartusiana* Müller وذلك خلال الفترة الممتدة من يناير إلى مارس ٢٠٠٩ حيث بدأت بدراسة تأثير بعض المواد الجاذبة والحاملة لجذب الأفراد من كلا النوعين خلال شهر فبراير ٢٠٠٩ هذا وقد أظهرت النتائج المتحصل عليها تسجيل أقصى قيمة للجذب عند استخدام الردة مع العسل الأسود مسجلة بذلك أعلى نسبة مئوية لجذب أفراد قوقع الحدائق البني وقوقع البرسيم الزجاجي مقدارها ٣٩,٤٧ و٤٠,٥٧ % على الترتيب في حين اظهر استخدام الردة مع الخميرة الجافة اقل المواد المختبرة تأثيرا على جذب أفراد كلا النوعين من القواقع.

يلي ذلك تقييم فعالية بعض المبيدات شائعة الاستخدام مثل بعض مركبات الفسفور العضوية والكارباميت وغيرها كطعوم سامة مستخدمة أفضل المواد الحاملة والجاذبة المختبرة سالفا ضد كلا النوعين من القواقع الأرضية وذلك أثناء فترة النشاط في مارس ٢٠٠٩ حيث أمكن ترتيب المبيدات المختبرة وفقا لمقدار النسبة المئوية للموت الناتجة ضد كلا النوعين من القواقع الأرضية بعد ١٥ يوم من المعاملة كما يلي: بروفينوفوس ، ايثيوبروفوس ، ميتالدهيد ، اوكساميل ثم انيلوفوس في حين اظهر دليل السمية لتلك المبيدات المختبرة أن مركبي ميتالدهيد ، بروفينوفوس هما الأكثر سمية مسجلان بذلك دليل سمية مقدارة ٨٨,٦ ، ٩٧,٣ و ١٠٠,٠ ، ١٠٠,٠ % لقوقع الحدائق البني وقوقع البرسيم الزجاجي على الترتيب بينما يأتي انيلوفوس في المؤخرة بهذا الصدد ضد كلا النوعين.

وأخيرا تم وصف الأعراض الظاهرية لموت الأفراد المسممة من كلا النوعين من القواقع الأرضية بالميتالدهيد والبروفينوفوس حيث أوضحت الملاحظات وجود اختلافات ملحوظة في أعراض الموت نتيجة التسمم لكل من المركبين: فعلى سبيل المثال نجد أن التأثير السمي لمركب الميتالدهيد يرتكز على دفع الأفراد لإفراز كميات كبيرة من المخاط مسببا الجفاف و قلة النشاط ، انكماش في العضلات و ظهور عضلات قدم مندغمة ومشدودة وقاسية وتظهر الأفراد سكون تام حيث تظل الأفراد بهذة الحالة لعدة أيام دون الموت المباشر وعلى النقيض تظهر أعراض الموت عند التسمم بالبروفينوفوس استمرارا في عمليات زحف الأفراد ببطيء وإفراز تدريجي للمخاط واستقرار في المحتوى المائي حيث تظل الأفراد نشطة وطرية وتتحرك بجسم منبسط طوليا ولوامس عينية ناتئة وفي النهاية تصبح الأفراد غير قادرة على الحركة ولكن في فترة زمنية أطول منها في حالة التسمم بالميتالدهيد.