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Biological and toxicological studies on the brown garden snail, *Eobania vermiculata*

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ABSTRACT

The effect of three types of soil; clay, sand and mixture of clay/sand (1:1) on the biological aspects of brown garden snails, *Eobania vermiculata* and the molluscicidal action of four different pesticides on the tested snails were investigated. Sand soils produced the largest numbers of clutches, eggs/clutch and eggs grooves with largest depth whereas, it gave the smallest diameter of eggs in comparison with the other two tested soils in this respect, although there were no significant differences between all three tested soils except the significance in the number of eggs/clutch between sand and clay soils. The growth rates of shell diameter of the snails were found to be increased with increasing the age from two to six months relatively in the rates in the three tested soils. So, there were no significant differences between the growth rates of shell in the tested soils. On the other hand, oxamyl and methomyl proved to be strong molluscicidal effects against the snails, *E. vermiculata* with LC_{50} values of 0.6 and 0.7%, respectively whereas, Glyphosate and carbofuran had moderately effects with LC_{50} values of 1.1 and 1.28 %, respectively.

INTRODUCTION

The brown garden snails, *Eobania vermiculata* are very serious pest which causes severe economic damage in agriculture, horticulture and forests; furthermore, they are importance in medical and veterinary practice, since they severe as intermediate hosts of certain parasitic worms of man and his domestic animals (Bishara *et al.*, 1968; Dekle, 1969, El-Okda, 1979 and 1981 and Godan, 1983). Therefore, it attracted the attention of certain scientists to study its biological aspects as well as its control by using different pesticides. El-Deeb *et al.* (1997 and 1999) found that *E. vermiculata* was the most abundant snails on different crops and vegetables at Beheira Governorate. They found also that the snails gave their eggs with

1-3; 3-5 and 2.0 clutches in sand, clay and mixture of the two soils, respectively. Baker (1986 and 1991) reported that *Theba pisana* laid eggs in holes 3-4 cm deep; each pair of snails laid up to 5 clutches with average 120 eggs by each snail per season. He recorded also that there was a significant positive correlations between shell size and total number of eggs produced by snails. On the other hand, the molluscicidal activity on different snails were carried out by using specific molluscicides and other chemicals including carbamates, oxime carbamates, organophosphorous and inorganic and fertilizers (Kassem and Abdallah, 1992; Radwan *et al.*, 1992; El-Deeb, 1999; El-Wakil, 1999; El-Wakil and Attia, 1999; and Sakovich, 1996).

This research was carried out to study the effect of soil type clay, sand and clay/sand (1:1) on the biological aspects of the brown snails (*E. vermiculata*) to measure the number of clutches, number of eggs/clutch, diameter of egg (cm), period of hatching, hatching percent (%), number of eggs grooves and depth of eggs grooves (cm). Four different pesticides (methomyl, glyphosate, carbofuran and oxamyl were tested for their lethal effects against the tested snail,*E. vermiculata* after 24, 48 and 72 hr.

MATERIALS AND METHODS

I. Tested Soils:

Three different types of soil; clay, sand and clay/sand soil mixture (1:1) were used. The soils were obtained from clean area free of pesticides at Sabahia zone, Alexandria. The soils were purified from weeds and different hard impurities; air and sun dried; grinded and sieved to get soft and homogeneous soil particles. The soils were autoclaved for one hour at 1.5 atm, pressure and then put the soil in glass jars (200 gm soil/each).

II. Tested animal:

The tested adult brown garden snails (*Eobania vermiculata*) were collected from the garden of Antonyades, Alexandria. The collected snails were kept in glass container for two weeks and fed on lettuce leaves.

III. Tested pesticides:

Four different pesticides were tested:

1- Methomyl 90% (Methavine) soluble powder; Rhone Poulence A.G.Company (U.S.A.).
2- Glyphosate 48 % (Lancer) Liquid; CFPI- French.
3- Carbofuran 10 % (Furadan) granules; F.M.C. Company (U.S.A.).
4- Oxamyl 24 % (Vydate) Liquid; E.I. Dupont Company (Inc.).

VI. Methods of Experiments:

1. Biological and physical studies:

Ten replicates (glass jars) were used for each type of the tested soils (clay; sand and clay/sand mixture, 1:1). Each replicate contained 200 g of soil; three mature of adult snails of *E. vermiculata* with average weight (2-3 g each) as well as lettuce leaves for feeding. Daily observation, fresh food supplying, cleaning and wetting the soil surface were conducted until eggs laying. Some physical aspects were measured to study the biological properties of the tested snail. The number of clutches, number of eggs/clutch, diameter of egg (cm) using special boklase (Vernier caliper type), time of hatching (day), percentage of hatching, number of eggs grooves and depth of eggs grooves were recorded. The growth rates of shell diameter were measured after 2, 4 and 6 months for the tested snails in all soils.

2. Toxicological studies:

Bran poison baits were prepared with 0.25, 0.5, 1.0 and 2% concentration for each pesticide. Three replicates (five snails, each) were used for each concentration. Controls (non-poison bait) were concurrently carried out. Number of dead snails after 24, 48 and 72 hr were recorded, mortality percentages and LC_{50} values (Lethal concentration that kill 50% of the snails compared to the control) were determined.

V. Statistical analysis:

The obtained data were expressed as mean ± SD and statistically analyzed using complete random design and ANOVA to determine the significant differences between treatments (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

1. Biological and physical measurements:

Some biological and physical aspects of brown garden snail (*E. vermiculata*) were measured and recorded in Table (1). There were no significant differences in number of clutches in all the tested soils, although the mixed soil produced the lowest number of clutches (1.86 ± 0.83) and the sand soil showed the highest number of clutches (2.57 ± 0.7). Thus, the number of eggs / clutch was the highest in sand soil (119.1 ± 54.6) followed by the clay soil (101.9 ± 30.9) and the mixed soil (76.3 ± 39.5),

respectively. The results showed also that there were no significant differences in the number of eggs/clutch between all the tested three soils. As a result of the large number of eggs/clutch in the sand soil, it produced the smallest diameter of eggs (0.33 ± 0.4) in comparing with the other two tested soils. The results agree with that reported by Tomiyama and Miyashita (1992). The number of eggs/clutch showed a significant difference between sand and clay soils. Concerning the time of hatching, it did not show significant differences between the three tested soils. The percentage of hatching was the highest in sand soil with 84.5 %, followed by clay and mixed soils with 76.8 and 69.5 %, respectively. These results may be due to the largest numbers of clutches and eggs as well as the smallest size of eggs in the sand soil. The results indicated that the largest number of eggs grooves (2.8 ± 0.7) with largest depth were found in the sand soil, which were significantly differ than clay soil and the mixed soils.

The average of the growth rates of shell diameter were determined for snails after 2, 4 and 6 months from starting the new hatching in the tested three soils are recorded in Table (2). Shell growth rates increased with increasing the age of snails in all the tested soils. So, shell diameter increased from 0.49 ± 0.2 to 0.8 ± 0.15 and 1.25 ± 0.4 cm in the clay soil; from 0.5 ± 1.6 to 0.86 ± 1.7 and 1.17 ± 0.16 cm in sand soil and from 0.49 ± 1.3 to 0.82 ± 1.4 and 1.15 ± 0.2 cm in the mixed soil after 2, 4 and 6 months, respectively. The results showed no significant differences between the tested soils at the different three phases and the growth rates of shell were relatively equal in each phase in the three types of soil.

Table (2): Growth rate of snails (*Eobania vermiculata*) reared in different types of soil at different ages.

Soil type	Shell diameter (cm)		
	Phase I after 60days	Phase II after 120 days	Phase III after 180days
Clay soil	0.49 ± 0.2[a]	0.8 ± 0.15[a]	1.25 ± 0.4[a]
Sand soil	0.5 ± 1.6 [a]	0.86 ± 1.7[a]	1.17 ± 0.16[a]
Clay/sand (1:1)	049 ± 1.3[a]	0.82 ± 1.4[a]	1.15 ± 0.2[a]
$LSD_{0.05}$	0.065	0.058	0.136

The data expressed as mean ± SD.

2. Molluscicidal activity of pesticides:

The effect of the tested pesticides on the brown garden snails, *E. vermiculata* is shown in Table (3). The number of the dead snails increased with increasing the tested concentrations and the time of exposure. Glyphosate did not cause death for snails after 24 hr whereas, carbofuran and oxamyl caused death except at their low concentrations (0.25 and 0.5 %). The accumulation effects of the tested pesticides increased the number of dead snails with increasing the time of exposure. Therefore, the number of dead snails increased after 48 and 72 hr of exposure in ascending order.

Tabl(3): Molluscicidal activity of some pesticides in baits against *Eobania vermiculata* at different periods .

Compound	Conc. %	Mean number of dead snail ± SD			Total of dead snails	Mortality % after 72 hr.	LC_{50}
		after 24 hr dead No.	after 48 hr dead No.	after 72 hr dead No.			
Control	0.0	0.0	0.0	0.0	0.0		
Methomyl (90 %)	0.25	0.66±0.45	1.33±0.5	1.66±0.47	5.0	33.3	0.7
	0.5	1.33±0.47	1.66±0.94	2.33±0.5	7.0	46.7	
	1.0	2.0 ± 0.0	2.0 ± 0.0	2.66±0.5	8.0	53.3	
	2.0	1.66±0.44	2.33±0.46	4.0 ±0.81	12.0	80.0	
Carbofuran (10 %)	0.25	0.0	0.33±0.47	0.66±0.46	2.0	13.3	1.28
	0.5	0.0	0.66±0.47	1.33±0.9	4.0	26.7	
	1.0	0.33±0.47	1.0 ± 0.0	2.0 ± 0.0	6.0	40.0	
	2.0	0.33±0.47	0.66±0.45	3.33±1.2	10.0	66.7	
Glypfosate (48 %)	0.25	0.0	0.33±0.5	0.66±0.44	2.0	13.3	1.1
	0.5	0.0	0.66±0.45	2.0 ± 0.82	6.0	40.0	
	1.0	0.0	0.33±0.47	2.66±0.94	8.0	53.3	
	2.0	0.0	1.33±0.47	3.67±0.47	11.0	73.3	
Oxamyl (24 %)	0.25	0.0	0.66±0.5	1.66±0.5	5.0	33.3	0.6
	0.5	1.0 ± 0.0	1.66±0.47	2.0 ±0.0	6.0	40.0	
	1.0	1.66±0.46	2.66±0.46	3.33±0.46	10.0	66.7	
	2.0	2.33±0.47	3.66±0.94	4.32±0.46	13.0	86.7	
$LSD_{0.05}$		0.61	1.03	1.27			

The mortality percentages after 72 hrs ranged from 33.3 to 80.0 % for methomyl; 13.3 to 66.7 % for carbofuran; 13.3 to 73.3 % for glyphosate and 33.3 to 86.7 % for oxamyl. Oxamyl and methomyl proved to be the most toxic chemicals against *E. vermiculata* where LC_{50} values were 0.6 and 0.7 %, respectively. Glyphosate and carbofuran were less effective in comparison with oxamyl and methomyl where LC_{50} values were 1.1 and 1.28 %, respectively. The tested pesticides can be arranged according to their lethal effect against *E. vermiculata* as follows:

Oxamyl > Methomyl > Glyphosate > Carbofuran

Thus, these tested pesticides could be recommended against *E. vermiculata* snails.

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دراســـات بيولوجيـــة وتكسكولوجية علي قوقع الحدائق البني (*Eobania vermiculata*)

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تم دراسة تأثير ثلاثة أنواع من التربة (الطينية – الرملية – خليط منهما بنسبة 1:1) علي الصفات البيولوجية لقوقع الحدائق البني (*Eobania vermiculata*) بالأضافة إلي تأثير أربعة أنواع مختلفة من المبيدات علي القوقع المختبر.
كانت أعداد كتل البيض ، عدد البيض/ كتلة ، عدد الأنفاق وعمقها أكبر في التربة الرملية عنها في النوعين الأخرين من التربة ، بينما كان متوسط قطر البيضة أقل في التربة الرملية بالمقارنة بالنوعين الأخرين من التربة. وبالرغم من أنه لم يكن هناك فروق معنوية بين الثلاثة أنواع من التربة فقد كانت هناك فروق معنوية في أعداد البيض/ كتلة بين التربة الرملية والتربة الطينية.
زادت معدلات النمو في قطر الصدفة لقوقع الحدائق البني بزيادة عمر القوقع من شهرين إلي ستة أشهرولم يكن هناك فروق معنوبة في معدلات نموالصدفة بين الثلاثة أنواع المختبرة من التربة.
و بالنسبة لتأثيرات السمية للمبيدات المختبرة علي قوقع الحدائق البني فقد أظهر مبيد الأوكساميل (24 %) ومبيد الميثوميل (90 %) تأثيرات إبادية قوية علي القوقع وكان التركيز المميت (LC_{50}) يساوي 0.6 ، 0.7 % لكلا من المبيدين علي الترتيب ، بينما أظهر المبيدين الجليفوسيت (84 %) والكاربوفيوران (10 %) تأثيرات إبادية متوسطة علي القوقع المختبر وكان التركيز المميت (LC_{50}) يساوي 1.1 ، 1.28 % لكلا من المبيدين علي الترتيب.