

Efficiency of some Natural Plant Extracts and Ferrous Sulphate in Controlling the Land Snail (*Monacha cartusiana*) under Laboratory and Field Conditions at Sharkia Governorate, A.R. Egypt.

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ABSTRACT

The effect of different concentrations of *Azadirachta indica* (neem) leaves' powder, *Calotropis procera* (oshar) leaves' powder, oshar' leaves crude extract, *Capsicum annum* (Cayenne or spicy red pepper) fruits' powder and *Piper nigrum* (black pepper) fruits' powder as natural extracts and ferrous sulphate as chemical compound were evaluated as attractive toxic wheat bran baits against the glassy clover snail *Monacha cartusiana* under laboratory and field conditions at Sharkia Governorate, A.R. Egypt. Results revealed that the tested materials exhibiting noticeable molluscicidal effects under both laboratory and field conditions. Mortality percentages increased with increasing concentration values and duration of exposure. Population reduction percentages revealed the same trend when the tested materials were applied 7 days post-treatment under field conditions. Ferrous sulphate was the most effective one followed by spicy red pepper, neem, black pepper, oshar fresh leaves' crude extracts and oshar leaves' powder extract where mortality percentage of effected snails were 100, 70, 50, 45, 45 and 10 respectively at highest concentration 7 days post-treatment. The parallel % population reduction values were 90, 70, 60, 50, 20 and 20 respectively.

Keywords: Some natural extracts, ferrous sulphate, *Monacha cartusiana*, Control

INTRODUCTION

Recently land snails had become one of economic serious pests in different Egyptian governorates causing serious yield reduction of infested filed crops and fruits (Nakhla and Tadros 1995). Among these pests, the glassy clover snails, *Monacha cartusiana* (Muller) which was considered the most predominant snails in all localities at Sharkia Governorate attacking agronomic, horticulture and ornamental plants (Mahrous *et al.* 2002). These pests have chewing mouth parts so they cause noticeable injuries in the leaves of the plants on which they feed and in some cases they bore into other parts of the attached plant.

The harmful snail species as *Monacha cartusiana* (Muller) cause direct bad effects on economy resulting from the feeding on various plants, daily activity (Foad, 2005). In addition, these pests secrete unsuccessful mucous substance on plants (Kassab and Daoud 1964) inhibits feeding of human and his domestic animals on that toxic plants that loss their marketing price in several countries (Baker & Hawke, 1990; Ittah & Zisman, 1992). Many investigators have drawn the attention to control the land snails

using chemical compounds (Ebenso *et al.*, 2004; Hegab *et al.*, 2013). On the other hand, edible baits containing a toxicant are the principal means of delivery of molluscicides in terrestrial gastropod control programs so, certain chemicals were investigated as poisonous baits against land molluscs where this technique was the preference chemical control method in this respect (Hegab *et al.*, 2013). The present work was conducted to study the efficacy of ferrous sulphate against the glassy clover land snail, *Monacha cartusiana* under laboratory and field conditions. Though some chemical compounds have been proved molluscicidal effectiveness in killing the snails, the use of these chemicals is not being encouraged nowadays due to environmental pollution (Smail *et al.*, 2010). Therefore, more efforts should be made to control the pest through the use of natural products derived from plant origin (Ismail *et al.*, 2010). In order to limit the use of chemical pesticides and avoid their harmful effects on the environment, many natural, attractive, deterrent and pest control materials have been investigated in recent times (Lindgren *et al.*, 1996 and

Govindachari *et al.*, 2000), as well as their high efficiency and differentiation with biodegradation.

The aim of this research is trying to control the glassy clover snail *Monacha cartusiana* by means of safe control (plant extracts) such as oshar leaves' powder, oshar leaves crude extract, neem leaves' powder, spicy red pepper powder and black pepper powder as natural substances under laboratory and field conditions in Sharkia governorate, Egypt comparing with ferrous sulphate as chemical compound.

MATERIALS AND METHODS

A- Laboratory experiment:

Tested snail : The glassy clover land snail *Monacha cartusiana* (Muller):

Health adults of the terrestrial snail, *M. cartusiana* were collected in plastic bag from infested Egyptian clover (*Trifolium alexandrinum*) field distributed at El-Asher men Ramadan district, Sharkia Governorate, Egypt and transferred to the laboratory. In the laboratory, snails were put in rearing containers (50 × 30 × 30 cm.) and fed daily on fresh cabbage leaves for acclimatization under laboratory conditions (El-Okda, 1981).

Tested materials :

1- *Calotropis* leaves : (Oshar' leaves)

Scientific name : *Calotropis procera*

Source : Oshar plant distributed at El-Asher men Ramadan district, Egypt.

The formulation of oshar' leaves crude extract was prepared by washing leaves carefully under tap water and crushing with negligible distilled water. Some of carefully washed leaves were dried perfectly at room temperature then were crushed to deliver oshar' leaves powder.

2- Neem dried leaves : were washed and dried by the same previous method

Scientific name : *Azadirachta indica*

Source : Neem plant distributed at El-Asher men Ramadan district

3- Black pepper :

Scientific name : *Piper nigrum*

Source : Perfumery of spices at El-Asher men Ramadan district, Egypt

The formulation of pepper extract as fruit powder.

4- Cayenne (spicy red pepper) :

***Capsicum annuum* Scientific name :**

Source : Perfumery of spices at El-Asher men Ramadan district .

The formulation of cayenne extract as fruit powder.

5- Ferrous sulphate :

The formulation of ferrous sulphate as solid salt (crystalline powder).

Scientific name : Ferrous sulphate

Chemical formula : FeSO₄

Source : Ferrous sulphate was obtained from El-Gamhouria Company for chemicals , Zagazig branch, Egypt.

Laboratory experiments :

Tested materials were used with three concentrations 0.5, 3 and 5% (W/W) as poisonous bran baits except for oshar' leaves crud extract was applied at the concentrations 3, 6 and 20% (W/W) that exhibit toxic effect against *Monacha cartusiana* snails.

Preparing of attractive poisonous baits :

The poisonous baits were prepared by incorporating the appropriate weight of tested material with wheat bran to give 100 parts of poisonous baits. In all cases, about 10 grams of poisonous baits were spread into each plastic box (3/4 kg. capacity) then, 10 snails were introduced into each box . The boxes were covered with muslin clothes and secured with rubber band to prevent snails from escaping (El-Okda, 1981). Control and Each treatment of each concentration separately were replicated 4 times. Control treatment was prepared using wheat bran bait without any compounds. Mortality percentages were recorded after 1,3,7 and 15 days according to (El-Okda, 1981).

Statistical analysis:

Statistical analysis were designed using Costat statistical software , 2005 Version 6.311. Mortality accumulation numbers of *Monacha cartusiana* at the highest concentration (5%) for spicy red pepper, neem' leaves powder, black pepper, Oshar' leaves powder, ferrous sulphate and 20% Oshar' leaves crude extract were analyzed.

B- Field experiment:

Field trials were performed at El-Asher men Ramadan district, Sharkia Governorate, Egypt at area of about one feddan cultivated with Egyptian clover (*Trifolium alexandrium*) heavy infested with the land snail *M. cartusiana*. The field was irrigated only day before any treatment. The tested materials were applied with one concentration (5%) by incorporating the tested material with wetted wheat brain bait and black sugar cane syrup was added as an attractive substance (indicated concentration + 95 part of bran + 5 par of black sugarcane syrup). About 100 gm of the tested baits were offered on plastic pieces 50x50 cm. Each treatment was replicated five times. Control treatment was designed by the same manner without any chemicals. Alive snails were recorded in check and treatment before and after 1,3,7,15,22 and 29 days post- treatment. Population reduction percentages were statistically calculated according to the equation of Henderson and Tillton equation (1955) as follows : % Reduction = $100 [1 - t_2r_1 / t_1r_2]$ where r1 and r2 are the

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

RESULTS AND DISCUSSION

Data in Table (1, 3) revealed the mortality accumulation numbers and mortality percentages respectively, using Ferrous sulphate spicy red pepper , neem' leaves powder, black pepper, crude extract of Oshar leaves and Oshar leaves' powder as poisonous baits against *Monacha cartusiana* under laboratory conditions during 15 days. Mortality percentages increased gradually with increasing the concentration values and the duration of exposure. The highest mortality percentages of *Monacha cartusiana* were recorded by ferrous sulphate treatments with values 45,75 and 100% at 0.5,3 and 5% concentrations 7 days post- treatment, respectively while the parallel values at spicy red pepper were 55, 55 and 70% at the same concentrations 7 days post- treatment, respectively .The effect of neem' dried-leaf extract was less where the mortality percentages were 25,40 and 50% at the same previous concentrations 7 days post- treatment, respectively. Mortality percentages were 30,30 and 45% respectively for black pepper followed by that of crude extract of oshar leaves 20,30 and 45%. oshar leaves' powder had the least toxic effect where mortality percentages were 0 , 5 and 10% with the same previous concentrations 7 days post- treatment, respectively. The lowest mortality percentages were detected with all concentrations after one day post- treatment. Finally, mortality percentages were ranged between 100- 100 for both ferrous sulphate, spicy red pepper and neem' leaves powder and ranged between 50-10 for both black pepper, Oshar leaves crude extract and neem' leaves powder with all concentrations after 15 days post-treatment respectively . Regarding general mean, the highest concentration (5%) of all tested materials except crude extract of oshar leaves (20%) gave 61.25, 52.5, 47. 5, 38.75, 28.75 and 6.25 for ferrous sulphate, spicy red pepper, neem' leaves powder, black pepper, oshar leaves crude extract and oshar leaves' powder respectively. After 15 days, mortality percentages were 100% for all concentrations of ferrous sulphate, spicy red pepper and neem' leaves powder while it reached 50,40 and 35 for black pepper, 50,35 and 25for oshar leaves crude extract and 15,10 and 0 for oshar' leaves' powder. In conclusion, ferrous sulphate exhibit higher toxic effect against *Monacha cartusiana* than, spicy red pepper, neem' leaves powder, black pepper, Oshar leaves crude extract and oshar leaves' powder. On the other hand, the descending order of the effectiveness of the tested natural plant extracts was, spicy red pepper, neem' leaves powder, black pepper, oshar' leaves crude extract and oshar' leaves' powder.

Table(2) revealed statistical analysis of mortality accumulation numbers of *Monacha cartusiana* treated with 5% concentration of ferrous sulphate, spicy red pepper, neem' leaves powder, black pepper, oshar' leaves powder and 20% oshar' leaves crude extract as baits under laboratory conditions after indicated days.

Statistical analysis of variances revealed that there is significant difference between the mortality

accumulation number of snails at all tested materials after 3,7 and 15 days where L.S.D was 1.32, 1.97 and 2.37 respectively. but there was no significant difference between values at 1day post- treatment.

Table 1. Mortality accumulation number of *Monacha cartusiana* treated with some natural plant extracts comparing ferrous sulphate as poisonous baits under laboratory conditions for 15 days.

Tested materials	Conc. %	Mortality accumulation number after indicated days			
		1	3	7	15
Ferrous sulphate	5	3	6	20	20
	3	2	4	15	20
	0.5	1	1	9	20
Spicy red pepper	5	1	7	14	20
	3	1	5	11	20
	0.5	0	2	11	20
Neem leaves powder	5	3	5	10	20
	3	1	1	8	20
	0.5	0	2	5	20
Black pepper	5	5	7	9	10
	3	2	5	6	8
	0.5	1	5	6	7
Oshar leaves crude extract	20	0	4	9	10
	6	0	3	6	7
	3	0	0	4	5
Oshar leaves powder	5	0	0	2	3
	3	0	0	1	2
	0.5	0	0	0	0
Control	0	0	0	0	0

Table 2. Statistical analysis of mortality accumulation numbers of *Monacha cartusiana* treated with 5% concentration of spicy red pepper, neem leaves powder, black pepper, Oshar leaves powder, ferrous sulphate and 20% Oshar leaves crude extract as baits under laboratory conditions after indicated days.

Tested materials	Mean			
	1 day	3 days	7 days	15 days
Ferrous sulphate	1ab	2 a	6.67 a	6.67 a
Spicy red pepper	0.33 b	2.33 a	4.67 b	6.67 a
Neem leaves powder	1 a b	1.67 a	3.33 b	6.67 a
Black pepper	1.67 a	2.33 a	3 b	3.33 b
Oshar leaves crude extract	0 b	1.33 a	3 b	3.33 b
Oshar leaves powder	0 b	0 b	0.67 c	1 b
L.S.D	N.S	2.37***	1.97***	1.32*

B- Field experiment:

Data in Table (4) revealed that the same trend was nearly observed when the tested materials were applied with 5% concentration under field conditions. The population reduction percentages of *Monacha cartusiana* treated with ferrous sulphate, spicy red pepper, neem leaves powder, black pepper, oshar leaves crude extract and Oshar leaves powder increased gradually with time of exposure till seventh day, then decreased. Ferrous sulphate exhibit higher molluscicidal efficiency than the tested natural extracts 7- days post- treatment where the reduction percentages were, 90,70,60,50,20 and 20 of *Monacha cartusiana* treated with ferrous sulphate, Spicy red pepper, neem leaves powder, black pepper, oshar leaves crude extract and oshar leaves powder respectively. These results are in agreement with the findings of Hegab, *et al.*; (2013) that copper sulphate and methomyle had molluscicidal effect against the land snails *Eobania*

vermiculata. These results are in agreement with the findings of Hattan (2004) that oshar plant has molluscicidal obvious effect against the land snail *Thepa pisana*. Hattan (2004) mentioned that the areal parts of oshar plant include the following active ingredients, Saponin, tannins, triterpenes, alkaloids, cardiac glycosides, flavonoids. Hesse *et al.*; (1950) and Sieber (1982) said that cardiac glycosides were recorded in Leaves, Latex and Stalk. Bali *et al.*; (1985) proved 100% molluscicidal effect of dry and aquatic extract of oshar leaves against *Limonia luteola* at 10000 ppm. Ismail *et al.*; (2010) established that neem extract known as (Neemazal T.S.) has molluscicidal effect against the adults of glassy clover snail (*Monacha cartusiana*) and revealed repellent effect against the juveniles under laboratory conditions. The most important bio-active constituents found in the neem tree is Azadirachtin, nimbin, nimbidin, nimbidol, sodium nimbinat, gedunin, salannin, quercetin (WWW. neemfoundation. org). spicy red pepper has flavonoids, Capsaicin concentrated in seeds. black pepper include flandriline, depatin, volatile oils as piperine (the active ingredient) in seeds (WWW.neemfoundation.org).

Table 3. Mortality percentages of *Monacha cartusiana* treated with some natural plant extracts comparing ferrous sulphate as baits under laboratory conditions for 15 days.

Tested materials	Conc. %	Mortality percentages after indicated days				General mean
		1	3	7	15	
Ferrous sulphate	5	15	30	100	100	61.25
	3	10	20	75	100	51.25
	0.5	5	5	45	100	38.75
Spicy red pepper	5	5	35	70	100	52.5
	3	5	25	55	100	46.25
	0.5	0	10	55	100	41.25
Neem leaves powder	5	15	25	50	100	47.5
	3	5	5	40	100	37.5
	0.5	0	10	25	100	33.75
Black pepper	5	25	35	45	50	38.75
	3	10	25	30	40	26.25
	0.5	5	25	30	35	23.75
Oshar leaves crude extract	20	0	20	45	50	28.75
	6	0	15	30	35	20
	3	0	0	20	25	11.25
Oshar leaves powder	5	0	0	10	15	6.25
	3	0	0	5	10	3.75
	0.5	0	0	0	0	0
Control	0	0	0	0	0	0

Table 4. Population reduction percentages of *Monacha cartusiana* (Muller) treated with 5% concentration of spicy red pepper, neem leaves powder, black pepper, Oshar leaves powder, ferrous sulphate and 20% Oshar leaves crude extract as poisonous baits under field conditions .

Tested materials	% population reduction after					
	1 day	3 days	7 days	15 days	22 days	29 days
Ferrous sulphate	30	40	90	70	30	18
Spicy red pepper	20	30	70	60	30	14
Neem leaves powder	14	26	60	50	20	10
Black pepper	12	20	50	40	10	8
Oshar leaves crude extract	6	10	20	10	5	0
Oshar leaves powder	4	10	20	4	0	0

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كفاءة بعض المستخلصات النباتية الطبيعية و كبريتات الحديدوز في مكافحة القواقع الأرضي مونكا كارتوسيانا (مللر) معمليا وحقليا بمحافظة الشرقية

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معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقي – الجيزة – مصر

تم تقييم تأثير تركيزات مختلفة لمستخلصات نباتية وهي مسحوق أوراق النيم , مسحوق أوراق العشار , العصير الخام لأوراق العشار الخضراء , مسحوق ث الفلفل الأحمر الحار و مسحوق الفلفل الأسود كمواد طبيعية و كبريتات الحديدوز كمادة كيميائية والتي استخدمت جميعها كطعوم جاذبة سامة ضد الأفراد اليافعة للقواقع الأرضي " مونكا كارتوسيانا: مللر." تحت الظروف المعملية و الحقلية بمحافظة الشرقية . - أوضحت النتائج أن جميع المواد المختبرة كان لها تأثير ابادى ملموس ضد القواقع تحت الظروف المعملية و الحقلية وأن النسبة المؤوية للموت و كذلك نسب الخفض في التعداد قد ازدادت بزيادة قيمة التركيز وفترة التعرض . كانت كبريتات الحديدوز أشد المواد المختبرة تأثيرا يليها مسحوق الفلفل الأحمر الحار , مسحوق أوراق النيم , مسحوق الفلفل الأسود , العصير الخام لأوراق العشار الخضراء ثم مسحوق أوراق العشار حيث بلغت نسبة الموت (100 , 70 , 50 , 45 , 45 , 10) % على التوالي وذلك عند تركيز 5% بعد 7 أيام من المعاملة لكل المواد المختبرة عدا العصير الخام لأوراق العشار الخضراء فقد كان تركيزه 20%. وكانت القيم الموازية لنسب الخفض في تعداد القواقع هي : 90 و70 و60 و50 و20 و20 على التوالي عند نفس التركيز. وفي ضوء النتائج الموضحة بالبحث فإنه يمكن التوصية باستخدام المستخلصات النباتية الطبيعية لكل من الفلفل الأحمر الحار , أوراق النيم , الفلفل الأسود , أوراق العشار في مكافحة القواقع الأرضي *Monacha cartusiana* وذلك للحفاظ على البيئة من التلوث بالمركبات الكيميائية . كما يوصى باستخدام كبريتات الحديدوز في مكافحة القواقع حال نقشى أعداده نظرا لشدة وسرعة تأثيرها وذلك لمنع وصول كثافته العددية إلى مستوى الضرر الاقتصادي .