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Efficacy Appraisement of some Compounds against *Monacha cartusiana* Snail Using Various Application Techniques, under Laboratory and Field Conditions

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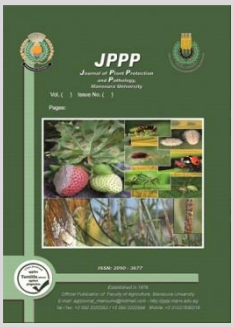

ABSTRACT

The efficacy of six pesticides belonging to different chemical groups namely (Neomyl 90% SP, Agrinate 24% SL, Mesurol 2% RB, Metarol 5% EG, Biogard 6.5% WP and Cranch 10% Sp) against the glassy clover snail *M. cartusiana* with various concentration and applications under laboratory and field conditions. Results showed that, under laboratory conditions the cumulative mortality percentage increases with the increase in the time of exposure to the pesticide, as well as the concentration rate. Data revealed that, Neomyl, Agrinate, Metarol and Mesurol were the most effective while Cranch and Biogard were the lowest. Regarding field trial, results revealed that, the efficacy of ready pellet baits was increased when applied by hand sowing than in piles on plastic pieces as in Metarol and Mesroul. Conversely, Neomyl and Agrinate exhibited the highest reduction percentage when applied as poisonous bait (piles on plastic pieces) than spray application. In concerning to Crunch and Biogard they show weak efficacy whether applied by poisonous baits or spraying

***Keywords*:** control, application methods, *Monacha cartusiana*

INTRODUCTION

Terrestrial molluscs are one of the most successful and diverse animal groups in land-based ecosystems (Barker, 2002). It is probably the third most important animal group after the arthropods and vertebrates (South, 1992). Among them class Gastropoda, that have land snails which consider one of the most destructive agricultural pests causing economic damage to wild variety of crops. In Egypt, land snails had become one of economic serious pests in different Governorates (Kassab and daoud, 1964 and Nakhla and Tadros, 1995). In Sharkia Governorate, *Monacha cartusiana* snails were the most predominant snails in all localities. It's attacking horticultural, ornamental, vegetable and field crops (Ismail, 1997; Mahrous *et al*, 2002 and Abed, 2017). Mainly damage caused by land snails is due to feeding and to contamination with their bodies, feces or slime, leading to deterioration of the product quality besides, and financial losses (Glesias *et al*., 2003). Today metaldehyde-based products predominate in the molluscicide bait market in most regions of the world.

In Britain, for example, bait products containing metaldehyde are used on 55% of the crop area treated with chemicals for gastropod control, compared with 40% for methiocarb- and 5% for thiodicarb-containing baits (Garthwaite and Thomas, 1996). *Bacillus thuringiensis* (Bt) produces chemicals toxic to many pests. At recent years, it became one of the biological control agents against several insect pests, (Dean, 1984). The toxicity of this bacterium against some land snails in Egypt has been studied by several researches (Azzam & Belal, 2003; Kramarz, et al., 2007 and Genena & Mostafa, 2008).

Molluscicides directed against terrestrial gastropods are only occasionally delivered as sprays or dusts but are more usually deployed in baits. For this reason, application technology is largely concerned with the composition of baits and how, where and when to apply them. Edible baits containing a toxicant are the principal means of delivery of molluscicidal chemicals in terrestrial gastropod control programmes (Barker, 2002). Therefore, the present study was conducted to evaluate the effect of some pesticides belonging to different groups applied by some application methods against *M. cartusiana* snail under laboratory and field conditions.

MATERIALS AND METHODS

Tested animals

Adult individuals of terrestrial snails *M. cartusiana* were collected from a severely infected field cultivated with Egyptian clover at Hehia elbalad- Hehia district- Sharkia Governorate. Collected snails were transported in a plastic container to the lab and fed on wheat bran to make acclimatization (El-okda,1981)

Chemicals used

Six compounds belonging to different chemical groups were used to evaluate their efficacy against *M. cartusiana* under laboratory and field conditions. Pesticides were obtained from Central Laboratory for Pesticides, Agricultural Research Center. The trade name, common name, recommended rate, and application methods are shown in Table (1).

Laboratory tests:

Tested compounds were used as poisonous baits at three concentrations (0.5 & 1 &1.5) from a recommended rate. The baits were prepared prior to the experiment, by mixing wheat bran with tested compounds and adequate water. About 10gm of poisonous baits were spread into plastic box (1/2 kg capacity) and ten healthy adult snails of

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M. cartusiana were introduced to each one. Control treatment was prepared as previously mentioned except no pesticides. Four replicates were used for each treatment and each box was covered with muslin clothes to prevent snails escaping (El-Okda, 1981). Mortality percentages were recorded at 1,3,7,14,21 and 28 days post treatment, and taking into account the removal of dead individuals. Mortality percentages were calculated and corrected using Abbott's formula (1925).

Table 1. The tested pesticides and their trade name, common name, application methods.

Trade name	Common name	Recommended rate	Application methods
Neomyl 90% SP	Methomyl	300g/F	Poisonous baits & Spray
Agrinate 24% SL	Methomyl	1L/F	Poisonous baits & Spray
Mesurol 2% RB	Methiocarb	2Kg/F	Poisonous baits & Hand sowing
Metarol 5% EG	Metaldehyde	2Kg/F	Poisonous baits & Hand sowing
Biogard 6.5% WP	*Bacillus thuringiensis*	1Kg/F	Poisonous baits & Spray
Crunch 10% SP	Copper Sulfate anhydrous	500g/F	Poisonous baits & Spray

Field trial:

This study was conducted with the aim of evaluating the use of different application methods of the aforementioned pesticides (Table 1) under field conditions. The experiment was carried out at a field of Egyptian clover on Hehia elbalad- Hehia district- Sharkia Governorate in March during the activity period of *M. cartusiana*. As one feddan was chosen for this study. A week prior to carrying out pesticide treatments the Egyptian clover was mowed, and the experiment area was irrigated one day before application

Application techniques:

a) Spray technique

The pesticides Agrinate, Neomyl, Biogard and Cranch in this technique were used by adding the recommended rate to 200-liter water/ feddan and applied on early morning before sun rise.

b) Poisonous baits (piles on plastic pieces)

The poisonous baits were prepared by mixing the recommended concentration of each pesticide with 5 parts of sugarcane syrup and incorporated with what bran to give 100 parts of poisonous baits mixed with adequate water (except Metarol and Mesurol which were applied as ready baits).

c) Hand sowing technique

This technique was restricted on Metarol and Mesurol which applied as ready baits by hand sowing with recommended rate 2kg/ F

In all cases, number of alive snails was recorded before application and after 1, 3,7,14 and 21 days post treatment. Reduction percentages were calculated according to the formula of Henderson and Tilton (1955).

RESULTS AND DISCUSSION

a- Laboratory experiment

The effect of certain compounds was tested against *M. cartusiana* as poisonous baits under laboratory conditions. Data in Table (2) showed that mortality percentages differ according to pesticide applied, concentrations and exposure periods. One-day post treatment, except Agrinate and Neomyl all pesticides failed to exhibit any molluscicidal activity. Furthermore, by time elapsed all tested pesticides began to show molluscicidal activity which increased gradually till to reach their peak at 28 days post treatment. Regarding the highest mortality percentages (85&92.5 %) it was observed after 7&14 days of exposure to Neomyl, respectively. Moreover, Agrinate reach highest level of mortality percentage (77.5%) after 14 days post treatment.

On the other hand, the lowest mortality percentage (2.5%) were recorded with Biogard treatment. Generally, it could be arranged the tested pesticides descendingly according to mortality percentages as a following: Neomyl, Aginate, Metarol, Mesurol and Crunch while Biogard noticed the lowest one.

Table 2. Effect of certain pesticides against *M. cartusiana* after periods of exposure to poisonous baits under laboratory conditions.

Pesticides	Con. %	Cumulative mortality percentages after indicated days					
		1	3	7	14	21	28
Agrinate 24% SL	0.5	0	5	35	47.5	47.5	47.5
	1	5	15	37.5	47.5	55	62.5
	1.5	5	45	62.5	77.5	77.5	77.5
Neomyl 90%Sp	0.5	2.5	30	30	32.5	37.5	37.5
	1	7.5	67.5	75	80	80	80
	1.5	20	75	85	92.5	92.5	92.5
Biogard 6.5%WP	0.5	0	0	0	0	0	0
	1	0	0	0	0	0	0
	1.5	0	0	0	2.5	2.5	2.5
Mesurol 2% RB.	0.5	0	10	25	27.5	27.5	27.5
	1	0	10	27.5	32.5	32.5	32.5
	1.5	0	30	30	32.5	37.5	37.5
Metarol 5% EG.	0.5	0	7.5	10	17.5	17.5	17.5
	1	0	12.5	20	37.5	42.5	42.5
	1.5	0	12.5	22.5	40	55	60
Cranch 10% Sp	0.5	0	0	0	0	0	0
	1	0	2.5	5	7.5	7.5	7.5
	1.5	0	2.5	7.5	10	12.5	12.5

b- Field trial

As for field experiment, the aforementioned pesticides were applied in different ways, whether by spraying or poisonous baits, as in the case of Agrinate, Neomyl, Biogard and Crunch. Data in Tables (3&4) revealed that the reduction percentages were affected by pesticides used and its application methods. Neomyl and Agrinate have the upper hand in reduction percentage when applied as poisons baits (piles on plastic pieces) where recording 90.35 & 83.77 %, respectively.

Reduction percentages were decreased when applied by spray method, where recorded 69.45& 65.75% for Agrinate and Neomyl, respectively. On the other hand, Biogard and Crunch recorded the lowest values of reduction percentages when it was applied using the spray method where gave 3.1 and 12.9 after 21 days, respectively. Conversely, in concerning with Metarol and Mesurol, it was used in the way of piles on plastic pieces and hand sowing.

Data present in Table (5&6) showed that, hand sowing has the highest influential in reduction percentages for both pesticides where recorded (94.84 &85.57%), respectively. After 21 days reduction percentages were recorded (90.86& 83.56%) for Metarol and Mesurol, respectively.

Generally, it can be concluded that ready pellet baits were highly efficacy when applied as hand sowing as in Metarol and Mesroul. Conversely, prepared baits whose results showed that, poisonous baits were more effective than spraying technique.

Table 3. Efficacy of some pesticides as poisonous baits (piles on plastic pieces) against *M. cartusiana* under filed conditions.

Pesticides	Reduction percentages after indicated days						Residual effect
	1 day	3 days	Initial effect	7 days	14 days	21 days	
Agrinate	13.18	3.19	8.185	62.97	70.17	83.77	72.30
Neomyl	22.36	47.83	35.095	68.50	74.05	90.35	77.63
Biogard	0	0	0	5.3	8.7	7.2	7.07
Cranch	0	1.3	0.65	8.7	11.21	15.5	11.80

Table 4. Efficacy of some pesticides as spray against *M. cartusiana* under filed conditions.

Pesticides	Reduction percentages after indicated days						Residual effect
	1 day	3 days	Initial effect	7 days	14 days	21 days	
Agrinate	2.17	13.68	7.925	40.13	57.41	69.45	55.66
Neomyl	14.80	10.42	12.61	32.17	50.03	65.75	49.32
Biogard	0	0	0	4.2	5.6	3.1	4.3
Cranch	0	0	0	6.8	9.3	12.9	9.67

Table 5. Efficacy of some pesticides as poisonous baits (piles on plastic pieces) against *M. cartusiana* under filed conditions.

Pesticides	Reduction percentages after indicated days						Residual effect
	1 day	3 days	Initial effect	7 days	14 days	21 days	
Metarol	39.04	52.84	45.94	67.88	77.90	90.86	78.88
Mesurol	18.58	43.57	31.075	58.93	65.35	83.56	69.28

Table 6. Efficacy of some pesticides as Hand sowing against *M. cartusiana* under filed conditions.

Pesticides	Reduction percentages after indicated days						Residual effect
	1 day	3 days	Initial effect	7 days	14 days	21 days	
Metarol	55.64	70.87	63.255	88.57	90.23	94.84	91.21
Mesurol	22.42	56.87	39.645	62.34	77.46	85.57	75.12

When the forgoing results discussing we can report that the molluscicidal activity were affected by compound used. These results, support the findings reported by Daoud, (2004) who found that Neomyl exhibited the highest toxic action against *M. cartusiana* under laboratory and field conditions. Also, Ismail *et al*., (2010) reported that under field conditions methomyl induced a higher effect on the population reduction than metaldehyde. Further, the present results are in accordance with these reported by Mortada *et al*., (2012) who reported that Gastrotox and Metarol exhibited the highest toxic action against *M. cartusiana*. The present results run parallel with Ismail and Shetaia, (2015) they proved that, Gastrotox have the highest reduction percentages after three days post treatment, while Biogard have the lowest one.

Finally, Ismail *et al*., (2022) illustrated that methomyl baits were effective the percent of reduction of *M. cartusiana, Succinea putris and Eobania vermiculata* when it applied on orchard tree and ornamental plants at highest concentration 3%

On contrary to the present study, Zedan *et al.*, (1999) reported that bacterial formulation (*B. thuringiensis* var. israelensis, serotype H-14, primary powder) was effective against the land snail compared with methomyl. Also, Mortada *et al*., (2012) demonstrated that, the biocides (Biogard and Crunch) reduced *Monacha* sp population density on pea plantation reach 28.03 & 62.80% after 21, respectively.

ElSabbagh *et al.,* (2013) found that under laboratory condition, *B. thuringiensis* causing 100% mortality against *M. cartusiana* post treatment in at 3x105 spores/ml. On the other hand, field application of *B. thuringiensis* as toxic spray on citrus trees of infected parts with adults of *M. cartusiana* snails by using 2x103 cfu/ml showed that mortality reached to 89% of snails within 21 days.

Regarding to methods of application, our study revealed that hand sowing was the best way for ready baits while the poisonous baits was the best in respect to prepared baits. This results in harmony with these reported by many authors. Barker *et al*., (1991) reported that molluscicides direct against terrestrial gastropods are only occasionally delivered as spray or dusts but are more usually deployed in baits.

With regarded *M. cartusiana* Lokma, (2013) demonstrated that, the reduction percentage in snail numbers was markedly increased with hand sowing compared with other two methods (under plant stack and put on plastic pieces) under field conditions. Moreover, Ismail *et al*., (2014) found that methomyl poisonous baits were more effective than spray technique. When poisonous baits were put as piles on plastic pieces, it was the best technique to reduce snail numbers of *M. cartusiana* than under plant stock and hand sowing, in Egyptian clover fields. Eventually, Abd El-Atti, *et al.,* (2020) reported that, Biogard inspire relatively high toxic impacts against clover snails *M. cartusiana*

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تقييم فاعلية بعض المركبات ضد قوقع *Monacha cartusiana* باستخدام تقنيات تطبيقية مختلفة ، تحت الظروف المعملية والحقلية

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الملخص

أجريت هذه الدراسة بهدف تقييم فاعلية ستة مبيدات تنتمي إلى مجموعات كيميائية مختلفة وهي (نيوميل ٩٠٪ SP ، أجرينيت ٢٤٪SL ، ميزارول ٢٪ RB ، ميتارول ٥٪ EG ، بيوجارد ٦,٥٪WP كرانش ١٠٪ SP) ضد القوقع الأرضي *M. cartusiana* بتركيزات وطرق تطبيق مختلفة تحت الظروف المعملية والحقلية. أظهرت النتائج أنه في ظل الظروف المعملية تزداد نسبة الموت مع زيادة وقت التعرض للمبيد وكذلك معدل التركيز. وأوضحت النتائج أن النيوميل والأجرينيت والميتارول والميزارول كانوا الأكثر فعالية بينما كان الكرانش و البايوجارد هما الأقل فعالية. أما فيما يتعلق بالتجربة الحقلية ، أوضحت النتائج أن فعالية طُعم الحبيبات الجاهزة تزداد عند تطبيقها بطريقة النثر مقارنة بإستخدامها بطريقة الأكوام كما في الميتارول والميزارول. على العكس من ذلك ، أظهر النيوميل والأجرينيت أعلي خفض في التعداد عند استخدامهما كطعم سام من رشهما. فيما يتعلق بالكرانش والبايوجارد فإنها تظهر فعالية ضعيفة سواء تم تطبيقها عن طريق الطعوم السامة أو الرش