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ASSESSING THE TOXICITY OF METHOMYL AND LAMBDA INSECTICIDES ON THE GLASSY CLOVER SNAIL

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ABSTRACT: This study was conducted to evaluate the toxicity of methomyl and lambda insecticides on the terrestrial snail, *Monacha cartusiana*. The two techniques are contact and leaf dipping techniques. The findings showed that the methomyl was more harmful to snails than lambda in both modalities. The contact method resulted in a higher fatality rate than the dipping method. The LC_{50} for methomyl and lambda on snails was (1.31 and 1.45%) /100ml, with mortality percent 93.2% after 24 hours using the contact technique. The LC_{50} of methomyl and lambda were 2.50 and 13.87 %/100ml on the second day, and 1.89 and 10.72 %/100ml on the sixth day, with mean death rates of 80.0±3.85% and 25.0±2.35%, respectively. It could be concluded that the contact technique was more effective against the terrestrial snail, *Monacha cartusiana* than the dipping technique. Moreover, methomyl was more toxic than lambda as a molluscicide for both techniques.

Key words: Methomyl, Lambda, toxicity Mortality, *Monacha cartusiana*

INTRODUCTION

Some species of terrestrial mollusks are regarded as pests in agroecosystems across the world; they cause crop damage and economic loss because of their high reproduction capacity, nocturnal activity, and eating habits (Routray and De, 2016; Ali, 2017; Das, *et al*., 2020). Land snails are recognized as significant agricultural pests in Egypt (El-Okda, 1979). Snail damage typically occurs by feeding on crops, leading to contamination through their moving on plant leaves leading to lesser-quality goods and less earnings. Additionally, snails have the potential to transmit diseases and serve as intermediate hosts for pathogens affecting humans and animals (Iglesias, *et al*., 2003; Heiba, *et al*., 2018).

According to Wafaa, *et al*., (2018) glassy clover snail species are regarded as a serious agricultural pest due to the damage to many economic plants in different parts of Egypt. Throughout the world, pesticides have been used to reduce the number of pests (Lance, *et al*., 2016).

Because of modern agriculture and intensive farming practices, the usage of these pesticides has grown (Tataji and kumar, 2016). They have toxicological effects on natural ecosystems (Moustafa, *et al*., 2016). Due to the ecological persistence of certain pesticides, there is a considerable risk of accumulation. Consequently, their use as insecticides has been restricted (Ohayo, *et al*., 1997).

Although, the most effective way to battle the control of terrestrial Mollusca nowadays is to use chemical pesticides (Ismail, *et al*., 2005 and Zedan, *et al*., 2006). Synthetic pyrethroid pesticides lambda-cyhalothrin (LCT) is used globally in agricultural, household pest management, food safety, and disease vector control. However, it has been demonstrated that LCT is bad for animal and human health. Numerous investigations have shown that it caused hepatoxicity and serious kidney structural damage and generated oxidative stress (Fetoui, *et al*., 2010, Al-Amoudi, 2018, El-Bialy, *et al*., 2020, Ali, *et al*., 2022, Sakr and Rashad, 2023 and Wang, *et al*., 2023).

Methomyl, also called Lannate 90%, is a mono methyl carbamate insecticide that is applied systemically to some crops to control pests. It was the most widely used and effective chemical agent for controlling snails (Khalil, 2016 and Khidr, 2019). Furthermore, according

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to Abdallah, *et al.* (2015), methomyl remains the most often used pesticide in the bait approach to control terrestrial gastropods. From the previous review, new and safe insecticides with distinct mechanisms of action are required for use as molluscicides. This study aimed to evaluate, in a lab setting, the molluscicidal effects of two pesticides, Lannate and LCT, on adult *Monacha cartusiana* (O. F. Müller, 1774) snails under laboratory conditions.

MATERIALS AND METHODS

1- The examined pesticides

Methomyl (Lannate 90 % SP), a carbamate pesticide, and Lambda-Cyhalothrin 5%EC, a pyrethroid pesticide.

2- Maintenance and feeding of land snails

In the spring of 2022, adult snails of the Glassy Clover Snail, *Monacha cartusiana* were collected from contaminated fields in Bany Magdoul village, located in the Kerdasa district of Giza Governorate, Egypt. The snails were carefully placed in closed bags and transported to the Malacology Laboratory at the Faculty of Agriculture, Al-Azhar University.

Healthy snails were housed in separate terrariums meaning 40 cm × 20 cm × 20 cm. The terrariums were filled with moist soil and had a perforated cover to ensure proper ventilation and prevent the snails from escaping. To meet their dietary needs, the snails were provided with fresh lettuce leaves (*Lactuca sativa*) as their daily food for a continuous two-week period. The snails were kept at a temperature of 20±2ºC, and the soil humidity level was maintained at 75% as recommended by Mobarak (2003).

3- Evaluation of Sensitivity of Adult Snails to Two insecticides

To assess the insecticidal properties of methomyl in comparison to Lambda-Cyhalothrin as a molluscicide, a range of concentrations was created using distilled water. The contact and dipping techniques were used to evaluate their effectiveness on the tested snails.

4- Toxicity Assessment Using the Contact Technique

The contact technique was used to evaluate the contact toxicity of two insecticides. where, various concentrations (0.5, 1, 1.5, 2, 2.5, and 3%) of two insecticides were applied to the bottom of a petri dish and evenly distributed by gently rotating the dish. The water in the droplets evaporated quickly at ambient temperature, leaving a residual film of the tested compounds.

Ten healthy snails from the experimental participants were subjected to the appropriate concentration of two tested insecticides for 24 hours. Each treatment received three duplicates, as well as an untreated control. Dead snails were collected within 24 hours according to Mourad (2014).

5- Toxicity Assessment Using the Leaf Dipping Technique

The leafy green lettuce was immersed in all of the concentrations of two tested insecticides for a brief period before being fed to the test animals. Untreated leaves were given as needed to consume over the next six days that had just been washed with water, Bashandy (2018). The death rates and half-lethal concentrations LC_{50} of the control insecticides were calculated after two and six days of treatment according to, Finney (1971) and the Bakr (2005) computer program.

RESULTS

1. The molluscicidal activity of two tested pesticides on land snails using contact technique.

The data in Figs. (1 and 2) and Table (1) show the effect of two tested insecticides on land snails' data after being treated with different concentrations using the contact technique.

The data in Fig. 1 revealed that methomyl and lambda insecticides achieved a high death ratio of 93.2% after a few hours of exposure at a concentration of 3%. Furthermore, after 24 hours methomyl and lambda at 2% and 2.5%, recorded moderate mortality percent 75% and 65%, respectively. While the remaining concentrations revealed death less than half of the snails.

The data in Table (1) and Fig (2) revealed that the LC_{50} for methomyl was 1.13 (1.08-1.54) % per 100ml, and for lambda was 1.45 (1.18-1.75) % per 100ml. Also, methomyl's LC_{90} was 3.604% per 100ml while lambda's LC_{90} was 4.873% per 100ml. As a result, methomyl caused the highest proportion of death when compared to lambda.

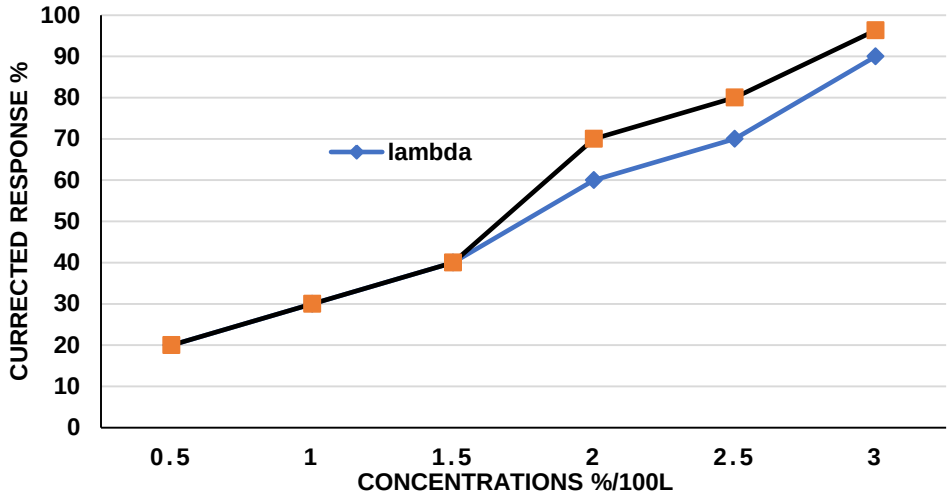

Fig. (1): The mortality rates of *M. Cartusiana* after treated with lambda and methomyl insecticides using the contact technique.

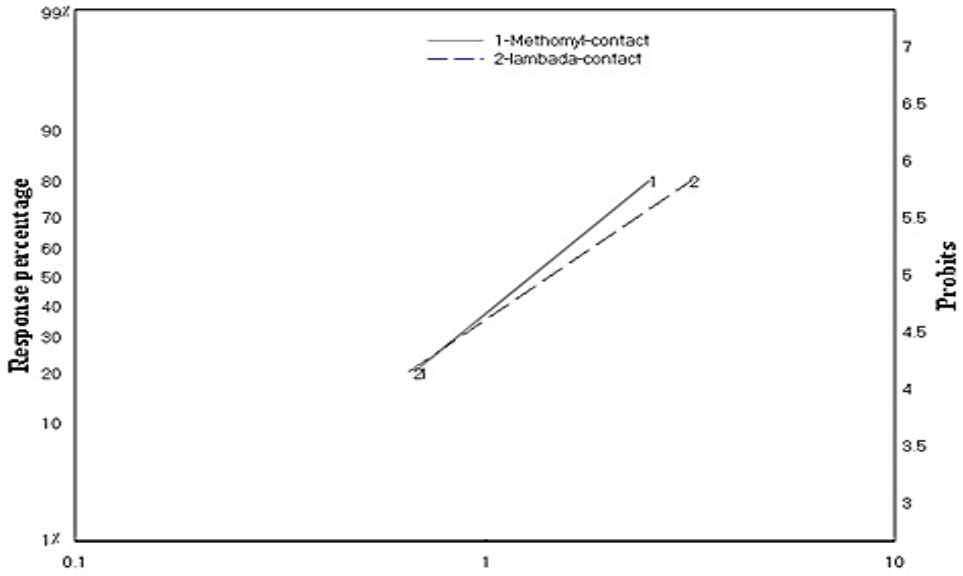

Fig. (2): The linear regression analysis of pesticide effects on M. cartusiana mortality using the contact method over 24h.

Table (1): LC_{50} and LC_{90} for lambda and methomyl on *M. Cartusiana* using the contact technique.

No	Line name	LC_{50} (% per100ml)	Lower limit	Upper limit	1	2	Index	RR	Slope	LC_{90} (% per 100ml)
1	Methomyl-contact	1.31	1.08	1.54	*	*	100	1	2.916	3.604
2	Lambada-contact	1.45	1.18	1.75	*	*	90.283	1.108	2.436	4.873

Index compared with Methomyl-contact Resistance Ratio (RR) compared with Methomyl-contact

The data in Tables (2 and 3) and Figure (3) revealed that methomyl induced the highest effect on land snails using the leaf dipping method Table 2, where it recorded the highest mean corrected response percent 80.0 % for snails during six days at concentration 3% and recording the highest. LC_{50} 1.89 % per 100ml during six days of treatment Table 3.

Therefore, lambda recorded 25.0±2.35 % mortality after six days, with LC50 of 10.72%/100 mL Tables (2 and 3).

Table (2): The mortality % of *M. cartusiana* induced by lambda and methomyl Insecticides using the leaf dipping technique.

Corrected mortality %						
Methomyl				Lambda		
Con. (%/100ml)	2nd	6th	Mean	2nd	6th	Mean
0.5	6.7	13.3	10.0±1.92^{d}	3.3	6.7	5.0±0.96^{e}
1	10.0	20.0	15.0±2.88^{cd}	6.7	10.0	8.3±0.79^{de}
1.5	16.7	30.0	23.3±3.84^{c}	10	13.3	11.7±0.78^{cd}
2	33.3	50.0	41.7±4.81^{b}	13.3	16.7	15.0±0.78^{bc}
2.5	46.7	53.3	50.0±1.92^{b}	16.7	20	18.3±0.79^{b}
3	73.3	86.7	80.0±3.85^{a}	20	30	25.0±2.35^{a}
control	0.0	0.0	0.0^{e}	0.0	0.0	0.0^{f}
$LSD_{0.05}$			9.489			4.127

Each plastic container contains 10 land snails based on three replicates (±) SEE.

At the 0.05 level, values in a column that is followed by the same letter are not statistically different.

Table (3): Toxicity of lambda and methomyl pesticides on *M. cartusiana* using the leaf dipping technique.

Days	Pesticides	Con. (%/100ml)	Lower limit	Upper limit	Slope± SRR
two days	Methomyl	2.50	2.1073	3.2563	2.90±0.55
	Lambda	13.87	null	null	1.30±0.57
six days	Methomyl	1.89	1.5767	2.338	2.54±0.45
	Lambda	10.72	null	null	1.21±0.4969

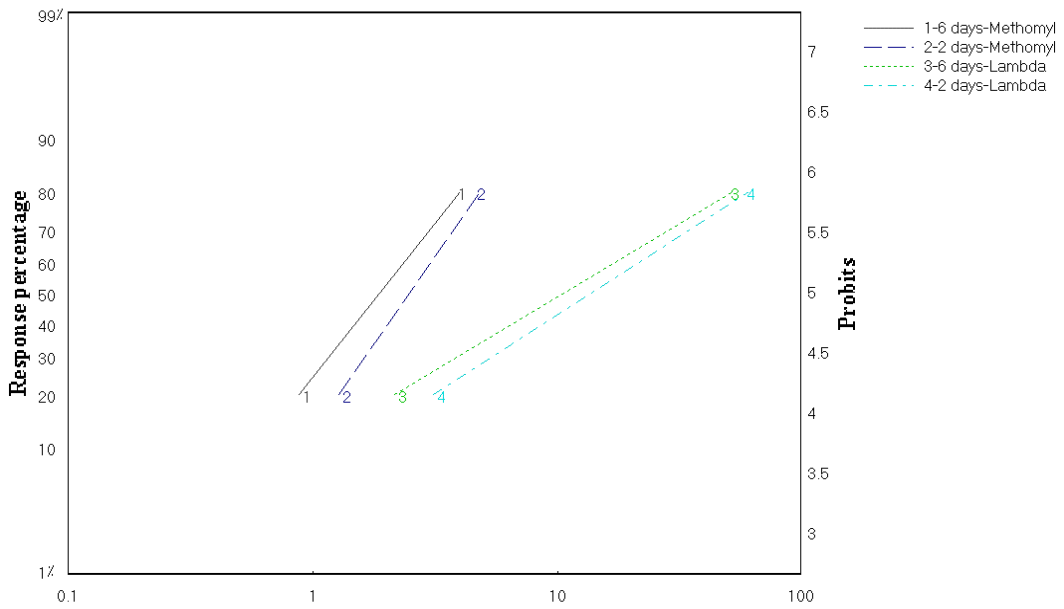

Fig. (3): Linear regression analysis of lambda and methomyl pesticides on *M. cartusiana* mortality during the exposure period using the leaf-dipping method.

DISCUSSION

The findings from earlier studies are consistent with the results reported by Hammond, *et al*., (1996), emphasizing the importance of proper pesticide application for their effectiveness. Incorrect application can lead to higher costs and adverse environmental consequences. Synthetic pyrethroids such as lambda, in agreement with Radwan and El-Wakil (1991) and Genena and Mostafa (2008), induce substantial mortality rates in treated snails such as chocolate-band snails and glassy clover snails. Hafez, *et al*., (2022) observed that Lambda was less successful than methomyl in terms of its influence on terrestrial snails, notably chocolate-band snails and small sand snails *in vitro* investigation using a leaf dipping approaches during 7 days. Furthermore, when compared to other insecticides with increasing concentrations, it was the most powerful agent against various species of terrestrial mollusk, causing one hundred percent death throughout the exposure period (Maaroof, *et al*., 2023)

In vitro and field conditions, using methomyl was very poisonous to land snails, *Monacha* sp. by contact technique and baits with different concentrations after a few hours of application (Hussein, *et al*., 1999; Ismail, *et al*., 2005; Genena and Mostafa, 2008; Ismail and Mohamed, 2009; Mortada, *et al.*, 2012 and Samy *et al.*, 2015)

Furthermore, Ali, *et ai*., (2020) concluded from this study that methomyl and other insecticides were effective in controlling tomato pests in Egypt, such as the chocolate-band snails, with the same dose. Furthermore, according to Bashandy and Raddy's 2021 investigation, methomyl had the highest amount of toxicity towards the glassy clover snail. The terrestrial snails were more vulnerable to methomyl, resulting in a 96% fatality rate among the animals examined. After 7 days, the LC_{50} values were obtained using leaf dipping procedures and were found to be 1.80%

CONCLUSION

Methomyl was more toxic to land snails than lambda. lambda was more effective in contact technique than the leaf dipping method. Because of the hazards of pesticides on macroinvertebrates and human life, these pesticides must be used with caution, and their discharge into the terrestrial environment must be properly monitored and regulated.

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تقييم التأثير السام للميثوميل واللمبادا على حلزون البرسيم الزجاجي

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الملخص العربى

اجريت هذه الدراسة لتقييم التأثير السام لمبيد الميثوميل ومبيد اللامبادا على الحلزون الأرضي *Monacha cartusiana*. فقد تم استخدام طريقتين للمعامله وهما الملامسة للمبيد، وغمر الورقة لتقييم فعالية هذه المبيدات على القواقع تحت ظروف المعمل. وأظهرت النتائج أن مبيد الميثوميل كان أكثر ضررًا على القواقع من مبيد اللامبادا في كلا الطريقتين. من ناحية أخرى، أدى تطبيق الملامسة للمبيد إلى معدل وفيات أعلى للقواقع من تطبيق غمر الورقة. ونتيجة لذلك، كان التركيز النصف مميت (LC_{50}) لمبيد الميثوميل واللامبادا على القواقع (١.٣١ و١.٤٥%) لكل١٠٠ ملليلتر، مع متوسط لنسبة الوفيات للقواقع بلغت ٩٣.٢% بعد ٢٤ ساعة باستخدام تطبيق الملامسة. علاوة على ذلك، كان التركيز النصف مميت (LC_{50}) في اليوم الثاني بالنسبة لمبيد الميثوميل واللامبادا والتي بلغت (٢.٥٠ و١٣.٨٧) % لكل١٠٠ملليلتر، وبلغت تلك النسبة فى اليوم السادس (١.٨٩ و١٠.٧٢) %/١٠٠ملليلتر، مع متوسط لمعدل الوفيات القواقع بلغ (٨٠.٠±٣.٨٥%)، (٢٥.٠±٢.٣٥%) على التوالي. ونتيجة لذلك، أدت كلتا الطريقتين إلى زيادة معدل الوفيات بزيادة التركيز. ونتيجة لذلك وبالمقارنة مع تطبيق طريقة غمر الورقة فى المبيدات، أدى تطبيق طريقة الملامسة إلى ارتفاع معدل الوفيات للافراد. كان مبيد الميثوميل أكثر سمية من مبيد اللامبادا كمبيد للرخويات في كلا الإجراءين.