J. of Plant Protection and Pathology, Mansoura Univ., Vol 12 (7): 447-451, 2021

Journal of Plant Protection and Pathology

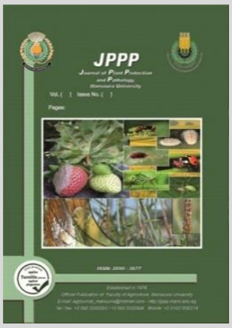
Journal homepage: www.jppp.mans.edu.eg
Available online at: www.jppp.journals.ekb.eg

In Vitro Assessment of The Efficacy of Metaldehyde, Methomyl and Copper Sulfate on some Terrestrial Gastropods.

Cross Mark

Bashandy, A. S.[1*] and H. M. Raddy [2]

[1] Department of Agricultural Zoology and Nematology, Faculty of Agriculture, Al-Azhar University, Egypt.
[2]Department of Plant Protection, Faculty of Agriculture, Al-Azhar University, Egypt.



ABSTRACT

Land mollusks are significant an economical pest invading diver's flora in Egypt. In the light of this trial, Evaluated the efficiency of chemical compounds as metaldehyde, methomyl and copper sulfate against two land snail's species as the chocolate-band snail, *Eobania vermiculata* and the glassy clover snail, *Monacha obstructa* related to families, Helicidae and Hygromiidae was inquired. The findings showed that metaldehyde was the most lethal complex against *M. obstructa* and *E. vermiculata* came after methomyl and copper sulfate through seven days after that, the values of lethal concentrations 50 were (1.03, 1.80 and 19.70 %) and (1.60, 9.18 and 89.38%), respectively. Furthermore, *M. obstructa* was more sensitive to methomyl, copper sulfate including metaldehyde compared to the brown garden snail. So, the compounds were caused % mortality, for the glassy clover, that (96, 96 and 84 %) respectively, whereas percentage mortalities for the brown garden snail were (96.48, 76 and 71.42%) for methomyl, metaldehyde and copper sulfate, respectively. Moreover, there is not dissimilarity of sensitivity between examined snails to methomyl. Additionally, mortality for snails was increasing by time exposure for compounds. This investigation displayed, copper sulfate can use as a molluscicide for land snails at concentration of 20 × 10^3 ppm, to give % mortality in a range of (55.17 – 96.0) %.

Keywords: Land snails; Metaldehyde; Methomyl; Copper sulfate

INTRODUCTION

In most regions of Egypt, terrestrial mollusks invade vegetables, field plants and trees as animal pests. So that, they lose them marketing value (El-Okda, 1980; Glen and Wilson, 1997; Glen *et al*., 2000).

The snails are mentioned before, they are among Egypt's most serious land snails such snails have a harmful effect on fruits and vegetables and often feed on the leaves of many ornamental plants and gardens. The regulation of these snails is therefore becoming very important. Currently, chemical pesticide management is also seeming as the more efficient approaches (Radwan *et al*., 1992; Eshra, 2004; Moran *et al*., 2004; El-Shahaat, *et al*., 2005, 2009; Ghoneim, 2006).

Copper salts does not play as a fungicide and algicide except, it applied as a molluscicide. Its high portions are hazardous in environment, effecting a final disturbance of the form of DNA and proteins, sooner or later main of their nonfunctioning (Hoffman and Zakhary,1953; Fitzgerald and Faust, 1963; Michaud and Grant, 2003; de Oliveira-Filho *et al*., 2004).

The goal of this laboratory looks at is to evaluate the toxicity for one of an insecticide for oximecarbamate, an inorganic and an organic compound as methomyl, copper sulfate and metaldehyde respectively, towards the two snails defined above.

MATERIALS AND METHODS

Animals

Adults of land snails; the chocolate-band snail, *E. vermiculata* (Müller) and the glassy clover snail, *M. obstructa* (Müller), have about the same age and size have been collected for laboratory examination. Those snails had been collected at some point in September from untreated nurseries of mango plants located in Abu-Rawash location, Giza Governorate, Egypt. They had been transferred in plastic sac to the lab. They had been kept as a minimum two weeks in aerated cages (32 × 21 × 25 cm, with 10 cm layer of moistened soil at the bottom: 100 snails in keeping with glass terrarium) for adaptation under room circumstances (23±1°C and 55±2% RH). They were identified counting on the essential guide given via way of Godan (1983). The animals were eating up leaves' iceberg lettuce, (*Lactuca sativa*). till the begin of trial. They were adapted to those circumstances for 14 days. deceased snails have been removed right away. The snails were starved for 24 h before the beginning of experiments.

Chemicals

Metaldehyde (Gastrox E 5% G), Methomyl (Lannate) 90% SP and copper sulfate (Sulfo Cup [CuSO4.4H2O – (25% Cu)] have been assessed.

Toxicity studies

Toxicity of the chemical compounds have been estimated against the two herbivorous land snails which alluded to above. [The weight about 10 g of the ready-made metaldehyde bait was ground and dissolved in 100 ml of distilled water to make a suspension of metaldehyde]. Identical size discs of lettuce leaves were immersing in sequence concentrations of the chemical compounds for 5 minute and use it after air-drying. The handled lettuce disks had been transferred into plastic

* **Corresponding author.**
E-mail address: aymanbashandy@azhar.edu.eg
DOI: 10.21608/jppp.2021.188620

beaker. Each plastic box was tightly covered with covers having holes (pierced with a pin) about one cm apart. The cover kept the air saturated with moisture and prevented the snails from escape. Ten samples of animals were put into every beaker and replicants three time. In addition to, untreated iceberg lettuce disks were used with distilled water only. Death percentages of examined animals have been counted at two periods: after three- & seven-days post treatments.

Death rate was rectified rely on Abbott's formula (Abbott, 1925). LC_{50} and slope values were counted depending on (Finney, 1971), using "Ldp line" software by Bakr (2000).

RESULTS AND DISCUSSION

Results

Effective of some chemical compounds against two snails; the chocolate-band snail and the glassy clover snail.

The obtained data in Tab. (1) and Figs. (1, 2) exhibited that, metaldehyde gave the % mortality values as (13.3, 16.6, 30.0, 33.3, 43.3 and 46.6) for the chocolate-band snail during three days of examination, whilst the values after seven days were (17.8, 21.4, 42.8, 46.4, 53.5 and75.0).

By observation, the death rations for *M. obstructa*, which were (16.6, 23.3, 30.0, 40.0, 43.3 and 50.0) after three days but it recorded after seven days (24.0, 40.0, 43.0, 52.0, 64.0 and 84.0). these findings pointed out, the values of LC_{50} for the chocolate band snail were 4.69×10^2 ppm at the first time and 1.60×10^2 ppm at second time. Whereas the values LC_{50} for the glassy clover snail were 4.04×10^2 ppm at 1st time and 1.03×10^2 ppm at 2nd time.

Tab. 1. Effectiveness of metaldehyde compound on the chocolate-band snail and the glassy clover snail.

Conc.{ppm}	% Mortality			
	The chocolate-band snail		The glassy clover snail	
	1st Time	2nd Time	1st Time	2nd Time
25	13.3	17.8	16.6	24.0
50	16.6	21.4	23.3	40.0
100	30.0	42.8	30.0	43.9
150	33.3	46.4	40.0	52.0
200	43.3	53.5	43.3	64.0
500	46.6	75.0	50.0	84.0
Slop ± S.E.	0.866 ± 0.248	1.271 ± 0.250	0.779 ± 0.241	1.213 ± 0.245
LC_{50} ppm × 10^2	4.69	1.60	4.04	1.03

1st Time = Three days – 2nd Time = seven days

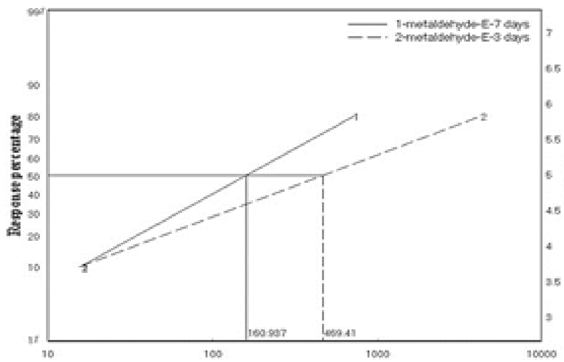


Fig .1. Linear Regression for Metaldehyde versus (E) *E. vermiculata* at different times of exposure.

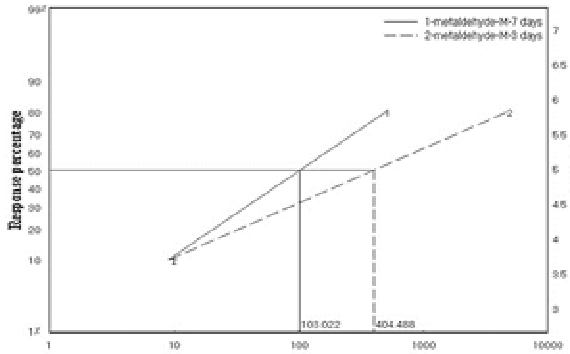


Fig. 2. Linear Regression for Metaldehyde versus (M) *M. obstructa* at different times of exposure.

Those results indicated; the metaldehyde compound had been the most effective for the tested snails at the second time. However, the effectiveness of this compound was medium for the two snails after three days. Furthermore, the death rate for testing snails was increasing by the time.

The efficiency of methomyl versus the examined snails displayed within Tab. (2) and Figs. (3) and (4). The % mortality values were 6.66, 13.33, 20.00, 36.66, 76.66 and 90.00 after three days of testing, while they were 3.57, 14.28, 32.14, 42.85, 82.14 and 96.42 after seven days for *E. vermiculata* snail. The values that correspond to *M. obstructa* were 3.44, 10.34, 17.24, 24.13, 34.48, 37.93 and 51.72 and 48.00, 52.00, 55.99, 76.00, 84.00 and 96.00 after three and seven days, respectively.

Tab. 2. Effectiveness of methomyl compound on the chocolate-band snail and the glassy clover snail.

Conc.{ppm}	% Mortality			
	The chocolate-band snail		The glassy clover snail	
	1st Time	2nd Time	1st Time	2nd Time
100	6.66	3.57	3.44	48.00
250	13.33	14.28	10.34	52.00
500	20.00	32.14	17.24	55.99
1000	36.66	42.85	24.13	76.00
2000	63.33	82.14	34.48	84.00
5000	76.66	92.85	37.93	88.00
10000	90.00	96.42	51.72	96.00
Slop ± S.E.	1.462 ± 0.179	1.919 ± 0.219	0.820 ± 0.161	0.872 ± 0.157
LC_{50} ppm × 10^2	14.67	9.18	85.08	1.80

1st Time = Three days – 2nd Time = seven days

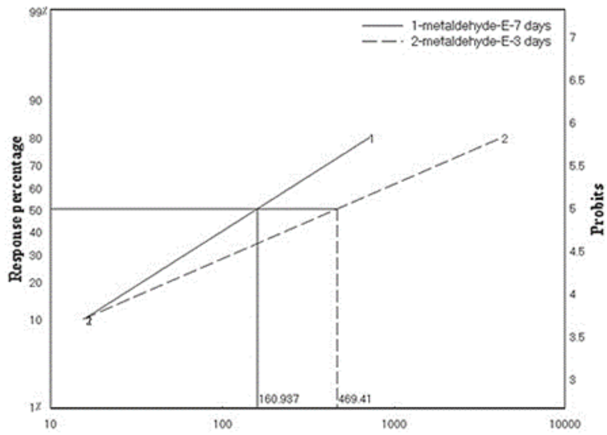


Fig .3. Linear Regression for Methomyl versus (E) *E. vermiculata* at different times of exposure.

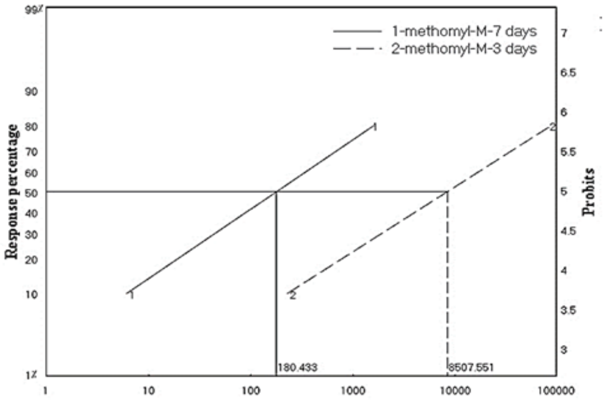


Fig .4. Linear Regression for Methomyl versus (M) *M. obstructa* at different times of exposure.

The values of LC_{50} for methomyl altered which recorded 14.67 × 10^2 ppm and 9.18× 10^2 ppm. It acted the highest death rate during two periods at the highest concentration for *E. vermiculata*. Whereas the death rate at highest concentration for *M. obstructa* was moderated percentage within three days which was 55.17 %, while it reached the highest death rate during the second period time which was 96.00%. So, LC_{50} was 85.08 × 10^2 ppm and 1.80 × 10^2 ppm after three and seven days, respectively.

The effectiveness of copper sulfate versus the two examined snails was lethal and highest during the second time comparison with the first time of trial. The obtained data in Tab. (3) and Figs. (5) and (6) exhibited that death rates were increasingly gradual with increasing concentration at concentrations (1000, 2500, 5000, 10000, 1500 and 20000 ppm) which (21.42, 25.00, 28.57, 46.42, 64.28 and 71.42%) after seven days, while these values were (13.33, 20.00, 23.33, 40.00, 53.33 and 56.66 %) at the first period of testing against *E. vermiculata*, respectively. the percentage of mortalities for *M. obstructa* snail were (43.99, 52.00, 60.0, 72.00, 84.00 and 96.00%) at the second period. Whilst the death rates at first time were (13.79, 20.69, 34.48, 37.93, 48.27 and 55.17%), respectively.

These results indicated that, the value of LC_{50} for the first snail were 154.64 × 10^2 ppm for three days and 89.38 × 10^2 ppm at seven days. Moreover, it recorded for the second snail 165.89 × 10^2 ppm at three days and 19.70× 10^2 ppm at seven days. Those results illustrated; the glassy clover snail was extremely influenced compared by the chocolate band snail.

Tab. 3. Effectiveness of copper sulfate compound on the chocolate-band snail and the glassy clover snail.

Conc.{ppm}	% Mortality			
	The chocolate-band snail		The glassy clover snail	
	1st Time	2nd Time	1st Time	2nd Time
1000	13.33	21.42	13.79	43.99
2500	20.00	25.00	20.69	52.00
5000	23.33	28.57	34.48	60.00
10000	40.00	46.42	37.93	72.00
15000	53.33	64.28	48.27	84.00
20000	56.66	71.42	55.17	96.00
Slop ± S.E.	1.055 ± 0.240	1.919 ± 0.219	0.920 ± 0.232	1.123± 0.227
LC_{50} ppm × 10^2	154.64	89.38	165.89	19.70

1st Time = Three days – 2nd Time = seven days

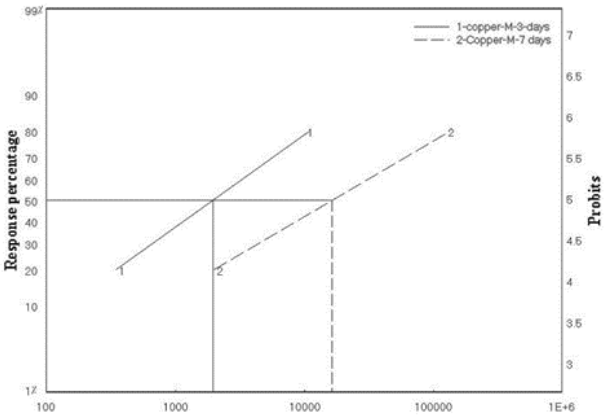


Fig .5. Linear Regression for copper sulfate versus (E) *E. vermiculata* at different times of exposure.

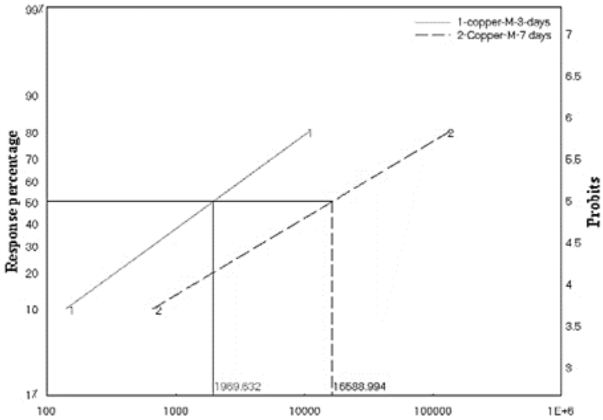


Fig. 6. Linear Regression for Copper sulfate versus (M) *M. obstructa* at different times of exposure.

Discussions

Previous findings are consistent with those came by Hammond, *et al.* (1996), declare that the effectiveness of pesticides depends on the good application of them, because the opposite leads to an increase in cost and impact on the environment. Chabert (1996) noticed that metaldehyde in its form as a commercial bait caused a death rate of 90% during the first period of exposure of terrestrial mollusks to it compared to methiocarb as bait, which caused a death rate of 68% during that period and then the effect of both decreased after that. Radwan & EL-Wakil (1991) discovered that methomyl had a greater effect on population decrease than oxamyl at field conditions versus *Monacha cartusiana* (Müller) and *Eobania vermiculata*. They discovered that, after one day of treatment to the bait prepared from wheat bran, with 2% methomyl added to it, it had a greater effect on *T. pisana* compared by the chocolate band snail, Abdallah, *et al*. (1992). In laboratory testing, Aioub, *et al*. (2000) discovered that several carbamate compounds were very poisonous to *M. cartusiana* snails. Also, Vertemic and Neomyl caused a high toxic against *E. vermiculata* snails, according to Daowd (2004). Further, under field settings, methomyl had the strongest residual impact against *M. cartusiana* snails, according to Ismail, *et al*. (2005). Furthermore, under laboratory and field circumstances, they observed; the chocolate band snail was more sensitive to abamectin and methomyl, Ismail and Hegab (2006). Besides, the value of LC_{50} for copper salts was more poisonous for *E. vermiculata* within 3.31percent compared with the other chemicals tested like methomyl and urea after 72 hours of testing by Eshra; 2014. In addition, According to Samy, *et al.*, (2015), they observed Neomyl was more effective chemical against the glassy clover snails under field circumstances. As well, Rizk, *et al.* (2017) demonstrated that molluscicides metaldehyde bait 2% caused the percentage mortality values (73.2, 76.4 and 73.4) to *E. vermiculata, T. pisana* and *M. cartusinna*, respectively in orange orchard trees.

Several research on the toxicity of copper and copper oxide nanoparticles to aquatic animals have been performed, and these researches have revealed that these compounds are hazardous to aquatic animals. (Isani, *et al*., 2013; Ates, *et al*., 2014; Wang, *et al*., 2015; Soliman, 2015; Abdel-Khalek, *et al*., 2016; Sun, *et al*., 2016). Also, the effect of copper sulphate on *Biomphalaria alexandrina* were observed by El Gindy (1969 a & b) Ragab, *et al*. (1998). They reported a marked reduction in the survival rate and in hatchability of eggs of *B. alexandrina* after treatment of snails with copper sulphate. Similar findings were reported by Mohamed, *et al*. (1981), Gawish (1997), and Ibrahim, *et al*. (1997). They found that the rate of infection of *B. alexandrina* and cercarial production decreased when snails were treated with sublethal concentrations of CuSO4. They displayed the copper salts was efficient to kill freshwater snails, *Oncomelania quadrasi* within every condition either the soils or the aquatic conditions, Kashifa Naghma, *et al.* (2017). Eshra (2014) displayed efficient the copper hydroxide compound versus the chocolate band snail and *T. pisana*. Moran and others; 2004, observed that the concentration one percent of copper hydroxide was more effective versus snail, *Theba pisana*.

REFERENCES

Abbott, W. S. (1925). A method of computing the effectiveness of an insecticide. Journal of Economic Entomology., 18: 265-267.

Abdallah, E.A.M.; Kassem, F.A. and Kadous, E.A. (1992). Laboratory and field evaluation of local bait formulations of certain pesticides against mollusca species. J. Pest Control Environ. Sci., 46, 179–192.

Abdel-Khalek, A. A.; Badran, S.R. and Marie, M. S. (2016). Toxicity evaluation of copper oxide bulk and nanoparticles in Nile tilapia, *Oreochromis niloticus*, using hematological, bioaccumulation and histological biomarkers. Fish Physiol. Biochem., 42(4):1225-36.

Ates, M.; Dugo, M. A.; Demir, V.; Arslan, Z. and Tchounwou, P. B. (2014). Effect of copper oxide nanoparticles to sheepshead minnow (*Cyprinodon variegatus*) at different salinities. Digest Journal of Nanomaterials and Biostructures, 9(1): 369-377.

Bakr, E. M. (2000). Ldp line 3. (Site of internet), http// WWW.ehab soft.com.

De Oliveira-Filho, E.; Lopes, R. M. and Paumgartten, F. J. R. (2004). Comparative study on the susceptibility of freshwater species to copper-based pesticides. Chemosphere, 56, 369–374. http: // dx. Doi .org/ 10.1016/j.chemosph ere.2004.04.02

EL-Gindy H. I. (1969a). Effect of molluscicides on the structure of eggs produced by treated snails. J. Egypt. Med. Assoc., 52: 141-150.

EL-Gindy H. I. (1969b). Copper sulphate as a molluscicide against *Bulinus truncat*us eggs in Iraq. J. Egypt. Med. Assoc., 52 (4): 245-257.

El-Okda, M. M. K., (1980). Land snails of economic importance on vegetable crops at Alexandria and neighboring regions. J. Agric. Res. Rev. Egypt, 58, 79–86.

El-Shahaat, M. S.; Eshra, E. H. and Abo-Bakr, Y. (2005). Impact of Basamide® and methomyl bait on non-target pests and microbiological processes in soil. Egypt J. Agric. Res. 83, 1007–1016.

El-Shahaat, M.S.; Mesbah, H.A.; EL-Naggar, A.Z. and Tayeb, E.H. (2007). The relative efficiency of pesticides and fertilizers on cotton crop. II. The side effects of certain pesticides and fertilization types on the soil enzymes, urease and dehydrogenase. J. Agric. Res. 12, 87–95.

El-Shahaat, M. S.; Aly, Nagda, A.; Eshra, E. H.; Mesbah, H.A. and Ghoneim, Emtiaz, I. (2009). Toxicity of certain copper fungicides and other pesticides to terrestrial snails. J. Agric. Sci. Mansoura Univ., 34 (5), 5501–5507.

Eshra, E. H., (2004). Studies on the Terrestrial Mollusca at Some Governorates of West Delta, with Special Reference to its Integrated Management. Ph.D. Thesis, Fac. Agric., Al-Azhar Univ., Egypt, 232pp.

Eshra, E.H. (2014). Toxicity of methomyl, copper hydroxide and urea fertilizer on some land snails. Annals of Agricultural Science, 59(2), 281–284.

Finney, D. J. (1971). Probit Analysis. Cambridge University. Press, 333 pp.

Fitzgerald, G. P. and Faust, S. L., (1963). Factors affecting the algicidal and algistatic properties of copper. Applied Microbiology, 11, 345–351.

Gawish, F.A. (1997). Evaluation of combination of certain molluscicides against *Biomphalaria alexandrina* and the free-living stages of *Schistosoma mansoni*. Ph.D. Thesis, Girls College for Arts, Sci. & Edu. Ain Shams Univ., Egypt.

Ghoneim, E. I., (2006). Studies on controlling the terrestrial mollusca on some horticultural crops. M.S.C. of Plant Protection. Fact of Agric. Alex. Univ. (Saba Basha), 128pp.

Glen, D.M. and Wilson, M.J. (1997). Slug-parasitic nematodes as biocontrol agents for slugs. Agro. Food Industry Hi-Tech., 8, 23–27.

Glen, D.M.; Wilson, M.J.; Brain, P.B. and Stroud, G. (2000). Feeding activity and survival of slugs Deroceras reticulatum exposed to the rhabditid nematode *Phasmarhabditis hermaphrodita*: a model of dose response. Biol. Control, 17, 73–81.

Godan, D. (1983). Pest Slug and Snails, Biology and control. Springer Verlag Berlin, Heidlberg, 445 pp.

Hoffman, D. O. and Zakhary, R. (1953). The relationship of exposure time to molluscicidal activity of copper sulfate. American Journal of Tropical Medicine and Hygiene, 2, 332–336.

Ibrahim, A. M.; Roushdy, M. Z.; Haroun, N. H. and Abdel-Hamid, H. (1997). Effect of sublethal concentrations of two molluscicides on the infection of *Echinostoma liei* to the snail vector *Biomphalaria alexandrina* in Egypt. Egypt. J. Appl. Sci., 12 (8): 370-391.

Isani, G.; Falcioni, M. L.; Barucca, G.; Sekar, D.; Andreani, G. and Carpene, E. (2013). Comparative toxicity of CuO nanoparticles and CuSO4 in rainbow trout. Ecotoxicol. Environ. Saf., 97: 40-46.

Ismail, Sh. A. A. and Mohamaed, D. M. O. (2009). Persistence of fresh prepared baits of certain pesticides tested at different intervals against *Monacha cartusiana* snails under laboratory conditions. Egypt. J. Appl. Sci., 24 (1): 274- 280.

Kashifa Naghma, W.; Zehra, K.; Nasir, H. N.; Imtiaz, B. and Sikender, H. (2017). Effect of copper sulfate on eradication of snail's specie, *Oncomelania quadrasi*, in aquatic habitats having *Labeo rohita* as a selected fish. Iranian J. of Fisheries Sci., 16(2) 800-814.

Michaud, J. P. and Grant, A. K., (2003). Sub-lethal effects of a copper sulfate fungicide on development and reproduction in three coccinellid species. Journal of Insect Science, 3, 16–22. http://dx.doi.org/10.1673/031.003.1601.

Mohamed, A. M.; EL-Fiki, S. A.; EL-Sawy, M. F. and El-Wakil, H. (1981). Effect of prolonged exposure of *Biomphalaria alexandrina* to low concentrations of some molluscicides. J. Egypt. Soc. Parasitol., 11: 295-311.

Moran, S.; Gotlib, Y. and Yaakov, B. (2004). Management of land snails in cut green ornamentals by copper hydroxide formulations. J. Crop Protec., 23, 647–650.

Radwan, M. A. (1993). A technique for testing the efficacy of molluscicdal baits against land snails. Comi. and Deve. Res., 43:17-26.

Radwan, M. A. and El-Wakil, H. B. (1991). Impact of certain carbamate and synthetic pyrethroid insecticides on the non-target terrestrial snail *Eobania vermiculata*. Alex. Sci. Exch., 12 (2): 305-316.

Radwan, M. A., El-Wakil, H. B., Osman, K. A., (1992). Toxicity and biochemical impact of certain oximecarbamate pesticides against the terrestrial snail, *Theba pisana* (Müller). J. Environ. Sci. Health, 27, 759–773.

Ragab, F. M.; Zidan, Z. H.; Sobeiha, A. K. and Abou-El-Hassan, A. A. (1998). The role of certain CuSO4-adjuvants on growth, fecundity and some biochemical aspects of *Biomphalaria alexandrina* snails. Ann. Agric. Sci. Fac. Agric. Ain Shams Univ. Cairo., 43(2): 607-621.

Rizk, A. M.; Y. A. Eisa; Y. M. A. Abd El Galil and M. I. Abd-Azeem. (2017). Effect of Some Protective Procedures in Integrated Pest Management Against the Surveyed Land Snails Species to Avoid Using of Pesticides in Orange Orchard at Tanta District, Gharbiya Governorate. Assiut J. Agric. Sci., (48) No. (5 (129-136)

Soliman, H. A.M. (2015). Accumulation of copper and DNA fragmentation in grass carp larvae after the exposure to copper oxide nanoparticles. Egy. J. Aquac., 5 (4):1-12.

Sturrock, R. F. (1966). The effect of sublethal doses of a molluscicide (Bayluscide) on the developmentof *Schistosoma mansoni* in *Biomphalaria sudanica tanganyicensis*. Bull. W HO., 34: 277- 283.

Sun, Y.; Zhang, G.; He, Z.; Wang, Y.; Cui, J. and Li, Y. (2016). Effects of copper oxide nanoparticles on developing zebrafish embryos and larvae. International journal of nanomedicine, 11: 905-918.

Wang, T.; Long, X.; Cheng, Y.; Liu, Z. and Yan, S. (2015). A comparison effect of copper nanoparticles versus copper sulfate on juvenile *epinephelus coioides*: growth parameters, digestive enzymes, body composition, and histology as biomarkers. Int. J. Genomics: 783021.

التقييم المعملى لفعالية الميتالديهيد والميثوميل وكبريتات النحاس على بعض البطنقدميات الأرضية

أيمن سعيد محمد بشندى[1]و حسنى محمد راضى[2]

[1]قسم الحيوان الزراعى والنيماتودا-كلية الزراعة بالقاهرة -جامعة الازهر

[2]قسم وقاية النبات- كلية الزراعة بالقاهرة -جامعة الازهر

أصبحت الرخويات الأرضية تمثل آفات اقتصادية مهمة تهاجم العديد من النباتات في مصر. في ضوء هذه الدراسة ، تم تقييم فعالية مركب الميتالديهيد والميثوميل وكبريتات النحاس كمبيدات للرخويات ضد قوقع الحدائق البني *Eobania vermiculata* وقوقع البرسيم الزجاجي *Monacha obstructa*. أظهرت النتائج بعد سبعة أيام من المعاملة إلى أن الميتالدهيد كان أكثر المركبات سمية ضد *E. vermiculata & M. obstructa* يليه الميثوميل وكبريتات النحاس حيث كانت قيم LC_{50} هى (1.03 ، 1.80 ،19.70٪) & (1.60 ، 9.18 ، 89.38٪). ، على التوالى - علاوة على ذلك ، كان قوقع البرسيم الزجاجي أكثر حساسية من قوقع الحدائق البنى لمركب الميثوميل وكبريتات النحاس والميتالدهيد. وتسببت المركبات من الميثوميل والميتالديهيد وكبريتات النحاس في نسبة موت لقوقع البرسيم الزجاجي والتى بلغت (96 و 96 و 84٪) بينما كانت نسبة الموت لقوقع الحدائق البني (96.48 و 76 و 71.42٪) وذلك على التوالى. علاوة على ذلك ، لم يكن هناك اختلاف في حساسية القواقع المختبرة للميثوميل. بالإضافة إلى ذلك زيادة فعالية سمية المركبات مع زيادة وقت التعريض. وأظهرت هذه الدراسة أنه يمكن مكافحة القواقع الأرضية باستخدام كبريتات النحاس كمبيد للرخويات بتركيز 20×10^3 جزء في المليون ، لإعطاء نسبة موت تتراوح بين (55.17 –96 ٪).