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Evaluation of Some Inorganic Salts Against Land Snails, *Monacha obstructa* and *Eobania vermiculata* under Laboratory and Field Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Effect of different concentrations of four inorganic salts (sodium hydroxide, potassium bromide, sodium nitrite, and copper sulfate) against the terrestrial snails, *Monacha obstructa* and *Eobania vermiculata*, was evaluated under laboratory and field conditions. Results commonly revealed that the tested materials exhibiting noticeable land snails impacts under laboratory and field conditions. In laboratory experiments, mortality percentages increased with the increase of concentration. Sodium nitrite was the most effective compound followed by copper sulphate, potassium bromide, sodium hydroxide for *Monacha obstructa* recording mortality percentages of 86.67, 80.00, 80.00 and 73.00%, respectively. The corresponding LC_{50} values were 8.69, 0.1548, 1.2966 and 4.7173% for the four inorganic salts, respectively. It was obvious that copper sulphate was the most effective followed by sodium nitrite sodium hydroxide, potassium bromide for *Eobania vermiculata*, where the

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mortality rate of infested snail reached 86.67, 80,80 and 60%, respectively at the highest concentrations of four salts. The corresponding LC_{50} values were 0.6901, 40.3541, 19.3519 and 12.037% for the four inorganic salts, respectively. It is interest to note that the used inorganic salts completely supressed egg production. Under field conditions, copper sulfate was more potent against *Eobania vermiculata* than sodium nitrite, but the reverse took place in case of *Monacha obstructa.*

Keywords: Monacha obstructa; Eobania vermiculata; Inorganic salts; Toxicology.

1. INTRODUCTION

Land snails had become one of economically significant pests in several Egyptian governorates causing yield reduction in fruits and infested field crops (Nakhla and Tadros, 1995). Among these pests, the glassy clover snails, *Monacha obstructa* (Muller) which was considered the most predominant snails in all localities at Qalyubia governorate attacking agronomic, horticulture and ornamental plants (Khidr, 2009). Also, *Monacha cartusiana* and *Eobania vermiculata* were recorded in Sharkia governorate (Bayoumi *et al*. 2024), These pests possess chewing mouthparts, which result in visible damage to the leaves of the plants they feed on. For instances, they also burrow into other parts of the affected plants, causing harm to a variety of plant species. This leads to significant economic losses in nurseries, orchards, and agricultural fields across many regions worldwide (Bonnelly, 1965; Calabrese et al., 1977). The harmful snail species like *Monacha cartusiana* (Muller) negatively impact economy resulting from the feeding on various plants (Foad, 2005). In addition, harmful snail species secret unsuccessful mucous substance on plants which inhibits feeding of human and his domestic animals on that toxic plants that loss their marketing price in several countries (Kassab and Daoud, 1964; Baker& Hawke, 1990; Ittah & Zisman, 1992). This study was carried out to assess the effectiveness of four inorganic salts (sodium hydroxide, potassium bromide, sodium nitrite, and copper sulfate) against the terrestrial snail, *Monacha obstructa* and *Eobania vermiculata*, under laboratory and field conditions.

2. MATERIALS AND METHODS

2.1 Tested Compounds

Inorganic salt. Four inorganic salts were tested, which are sodium hydroxide (NaOH) and sodium nitrite ($NaNO_3$), each salt is white powder 99%, potassium bromide (KBr) and copper sulfate ($CuSO_4$). All tested salts were produced by Biochem Chemicals for Libraries.

Experimental animals: Adult ground snails were gathered from Egyptian clover fields (*Monacha obstructa*) and citrus trees (*Eobania vermiculata*) in Shiblinga village (31.2621956, 30.472958), located in the Banha district of Qalyubia Governorate.The animals were relocated to the laboratory. and housed in glass boxes containing moist soil (5-10 cm height). Each glass boxes was covered with gauze to prevent the snails from escaping. Fresh green lettuce was provided for acclimatization purposes, and calcium powder was sprinkled on the soil surface twice a week to serve as a calcium source. The glass containers were regularly cleaned to remove dead animals and breeding waste.

Laboratory experiments: Snails were exposed to various concentrations of the tested salts for seven days using the thin-film technique. This contact method was conducted following the procedure outlined by Asher and Mirian (1981). Each salt concentration was prepared with water and applied in a Petri dish. Two ml of the solution were distributed evenly across the inner surface of the dish by gently rotating it, allowing the water to evaporate at room temperature within a few minutes, leaving a thin film of the compound on the dish's surface. The land snails were then subjected to these different concentrations for one week, with three replicates per concentration. A control test, using water only, was also included. Dead snails were counted and removed daily, and mortality percentages were recorded. The Mortality percentages were corrected according to Abbott’s formula (1925) to ensure accuracy.

$$\text{Abbott's formula} = 1 - \frac{\text{No. of snails in treatment after treatment}}{\text{No. of snails in control after treatment}} \times 100$$

Effect of four inorganic salts on snail’s productivity: Latent effect of survival snails exposed to low concentrations of sodium hydroxide, sodium nitrite, potassium bromide and copper sulfate were maintained in laboratory until death to investigate its capability to laying egg masses in comparison to untreated snails. The snails were fed daily on fresh lettuce. The numbers of eggs/snail were recorded weekly for four weeks.

Field application: Copper sulfate and sodium nitrite were tested against the two land snail species under field conditions at Qalubyia Governorate Banha district (Shiblanga) on plantation of citrus nursery trees against *Eobania vermiculata* and *Monacha obstructa.* Twelve plots were divided (each of 4 m^2) as four replicates for each compound and for the untreated control. Each plot was far from the other by at least 4 meters distance. The tested compounds were applied as a trunk spray. The snails infested plants were counted in each plot, pre as well post treatment during 1,3,7,15 days. The efficiency of salts was based on the reduction of snails population after 1,3,7,15 days of treatment according to the formula of Henderson and Tilton (1952). as follows:

$$\text{Population Reduction\%} = 1 - \frac{(\text{ C1} \times \text{ T2})}{(\text{ C2} \times \text{ T1})} \text{ x } 100$$

C1= Number of snails in control before application. C2= Number of snails in control after application. T1 = Number of snails in treatment before application. T2 = Number of snails in treatment after application.

3. RESULTS

Laboratory studies: In this investigations the tested inorganic salts, namely sodium hydroxide, sodium nitrite, copper sulphate and potassium bromide were evaluated against land snails, *Monacha obstructa and Eobania vermiculata.* The evaluation of the tested toxicants was compared as follows:

3.1 Comparison on Basis of Mortality Percentages, LC_{50} and LC_{90}values

3.1.1 Effect on Land Snails, *Monacha obstructa*

Results presented in Table (1) and illustrated graphically in Fig. 1. showed that the concentrations of copper sulfate of 0.0625, 0.125, 0.25 and 0.5% caused 26.66,40, 66.66, and 80% mortality, respectively, while sodium hydroxide achieved 20, 40, 60, and 73.33% mortality for concentrations of 1.56, 3.125, 6.25, and 12.5%, respectively. Furthermore, sodium nitrite gave 13.33, 26.66, 46.66, 66.67, and 86.67% mortality at the rate of 2, 5, 10, 15, and 20%, respectively, while potassium bromide recorded 6.66, 13.33, 33.33, 53.33 and 80% mortality at the concentrations of 0.195, 0.39, 0.78, 1.56 and 3.125%, respectively. The requised equitoxic values, i.e. LC_{50} and LC_{90} values represented in Table (1) and depicted in Fig. (1) cleared the toxicity of the tested four inorganic salts that mentioned previously against land snails, *M. obstructa.* The obtained data indicated that the trend of the toxicity of the tested toxicants was similar at the two determined LC_{50} and LC_{90} values. It was obvious that copper sulphate as well potassium bromide were the most promising inorganic salts against land snails, *M. obstructa* at the two levels of evaluation, i.e. LC_{50} and LC_{90} values. On the other hand, sodium nitrite was the least efficacy toxic compound against *M. obstructa.* The inorganic salt, sodium hydroxide occupied the meddile situation among the other three toxicauts. Generally, based the LC_{50} and LC_{90} values against land snails, *M. obstructa,* the efficiency of the tested products could descendingly arranged in order as follows: copper sulphate, potassium bromide, sodium hydroxide and sodium nitrite. The corresponding LC_{50} and LC_{90} values were 0.1548 & 0.8834, 1.2966 & 5.747, 4.7173 & 28.6236 and 8.69 & 35.469%; respectively.

3.2 Evaluation against Land Snail, *Eobania vermiculata*

The tested four inorganic salts were evaluated against the land snail, *E. vermiculata* via determining the mortality percentages as well as both LC_{50} and LC_{90} values. In this study, the toxicity of the four tested inorganic salts against *E. vermiculata* via on basis of mortality percentages is summarized in Table (2) and depicted graphically in Fig. (2).It is clear that there was positive correlation between concentrations used of the toxicants and the resulted mortality percentages. In other words, mortality percentages were increased with increasing the concentration of tested products. The implemented concentrations used for Sodium hydroxide; I.e. 1.56, 3.125, 6.25, 12.50 caused 13.33, 40, 60 and 80% mortality; concentrations used in case of sodium nitrite were 2, 5, 10, 15 and 20 exhibited 13.33 ,20, 46.67, 66.67and 80% mortality. For potassium bromide, the tested concentrations 0.195, 0.39, 0.78, 1.56 and 3.125 recorded 6.66, 6.66, 26.66, 46.66 and 60% mortality. Concerning copper sulphate , the tested concentrations of copper sulphate 0.0625, 0.125, 0.25, 0.5% gave 20, 33.33, 60 and 86.77% mortality. On the other light of comparison on basis of LC50 and LC90 values, the obtained results are shown in Table (2) and illustrated graphically in Fig. (2). It was obvious that similarity trend of the implemented toxicity of the four inorganic compound at the two LC_{50} and LC_{90} values was clear noticed. According to both LC_{50} and LC_{90} values, the toxicity of the tested inorganic salts used in the investigation could be descendingly arranged in order as follows: copper sulphate, potassium bromide, Sodium hydroxide and sodium nitrite, the corresponding LC_{50} and LC_{90} values were 0.1757 & 0.6901; 2.0149 &12.037; 4.6985 & 19.3519 and 9.5608 & 40.3541% ; respectively.

3.3 Comparison on Basis of Toxicity Index Values

In this respect, sun (1950) decribed the toxicity index as a mean for comparing the relative toxicity of insecticides. In comparing the toxicity of the tested inorganic salts against *M. obstructa* according to toxicity index are shown in Table (3) and illustrated in Fig. (3). In this investigation, copper sulphate (the highest toxic) was taken the standard compound and given the arbitraryindex values as 100 units. It was obvious that the toxicity index values at LC_{50} and LC_{90} levels of Sodium hydroxide,sodium nitrite and potassium bromide against land snails, *M. obstructa* were 3.28 & 3.09, 1.78 &2.49 and 11.94 & 15.37% as toxic as the toxicity of copper sulphate; respectively. It could be noted that the obtained results revealed that toxicity values at both LC_{50} and LC_{90} levels showed similar trend. In case of the land snails, *E.vermiculata,* copper sulphate was the most promising toxic product as presented in Table (4) and illustrated graphically in Fig. (5) which selected as standard toxicant in this study and given the arbitrary index value 100 units . It is clear that the toxicity index values at LC_{50} and LC_{90}levels of Sodium hydroxide, sodium nitrite and potassium bromide against the land snails of *E. vermiculata* recorded 3.739 & 3.567; 1.838 & 1.710 and 8.720 & 5.733% as toxic as the toxicity of copper sulphate; respectively.

3.4 Comparison on basis of slope values of toxicity lines, LC_{90}/ LC_{50} ratio and relative potency levels agains land snails, *M. obstructa*

The obtained data are presented in Table (5) and illustrated graphically in Fig. (5): It is demonstrated that the steepest toxicity line was noticed in case of treating the inorganic salt, sodium nitrite against *M. obstructa,* the corresponding slope value of the toxicity line was 2.098.On the other hand, the flattest one was observed in case of treating the inorganic salt, sodium hydroxide, where the corresponding slope value of the toxicity line recorded 1.636. The slope value of potassium bromide and copper sulphate occupied the meddile situation among the tested toxicants, the corresponding slope value of toxicity lines was 1.981 and 1.694; respectively. The above mentioned conclusionis correct whether it is the slope values of the LC_{90}/ LC_{50} ratios, since the later method simply expressed the steepness of the Ld.P lines in a reversal way to the slope values. Therefore, an increase in slope value is paralled to decrease in LC_{90}/ LC_{50} ratios. As summarized in Table (5) and depicted in Fig. (5), the relative potency levels expressed as number of folds were obtained by dividing the LC_{50} or LC_{90} for the least toxic compound by the other tested products. Through the light of relative potency levels, results showed that similarity in the order of the potency levels at both $LC_{50}$and LC_{90}values against land snails, *M. obstructa.* It was obvious that sodium nitrite the least toxic one was taken as a standard agent at the LC_{50} and LC_{90} values. The relative toxicity of the tested inorganic salts Sodium hydroxide, potassium bromide and copper sulphate at both LC_{50} and LC_{90} values were 1.842 & 1.239, 6.702 & 6.171 and 9.837 & 20.937 folds as toxic as the toxicity sodium nitrite against land snails, *M. obstructa*; respectively.

3.5 Comparison on basis of slope values of toxicity lines, LC_{90}/ LC_{50} ratio and relative potency levels agains land snails, *E. vermiculata*

Results shown in Table (6) and depicted in Fig. (6) cleared that the Slope values of toxicity lines could be descendingly arranged in order as follows: copper sulfate, sodium hydroxide, sodium nitrite and potassium bromide; the corresponding Slope values were 2.156, 2.084,

Table 1. Effect of four inorganic salts against terrestrial snail, *M. obstructa*, after treatment

	Monacha obstructa				
Salts	**Concentration (%)**	**Mortality (%)**	**LC_{50} (%)**	**LC_{90} (%)**	**Slope+/-SE**
Sodium hydroxide	1.56	20	4.7173	28.6236	1.6367 +/- 0.2054
	3.125	40			
	6.25	60			
	12.5	73.33			
Sodium nitrite	2	13.33	8.69	35.4697	2.0981+/- 0.1935
	5	26.66			
	10	46.66			
	15	66.67			
	20	86.67			
Potassium bromide	0.195	6.66	1.2966	5.7474	1.9819+/- 0.1708
	0.39	13.33			
	0.78	33.33			
	1.56	53.33			
	3.125	80			
Copper sulphate	0.0625	26.666	0.1548	0.8834	1.6941+/- 0.2057
	0.125	40			
	0.25	66.66			
	0.5	80			

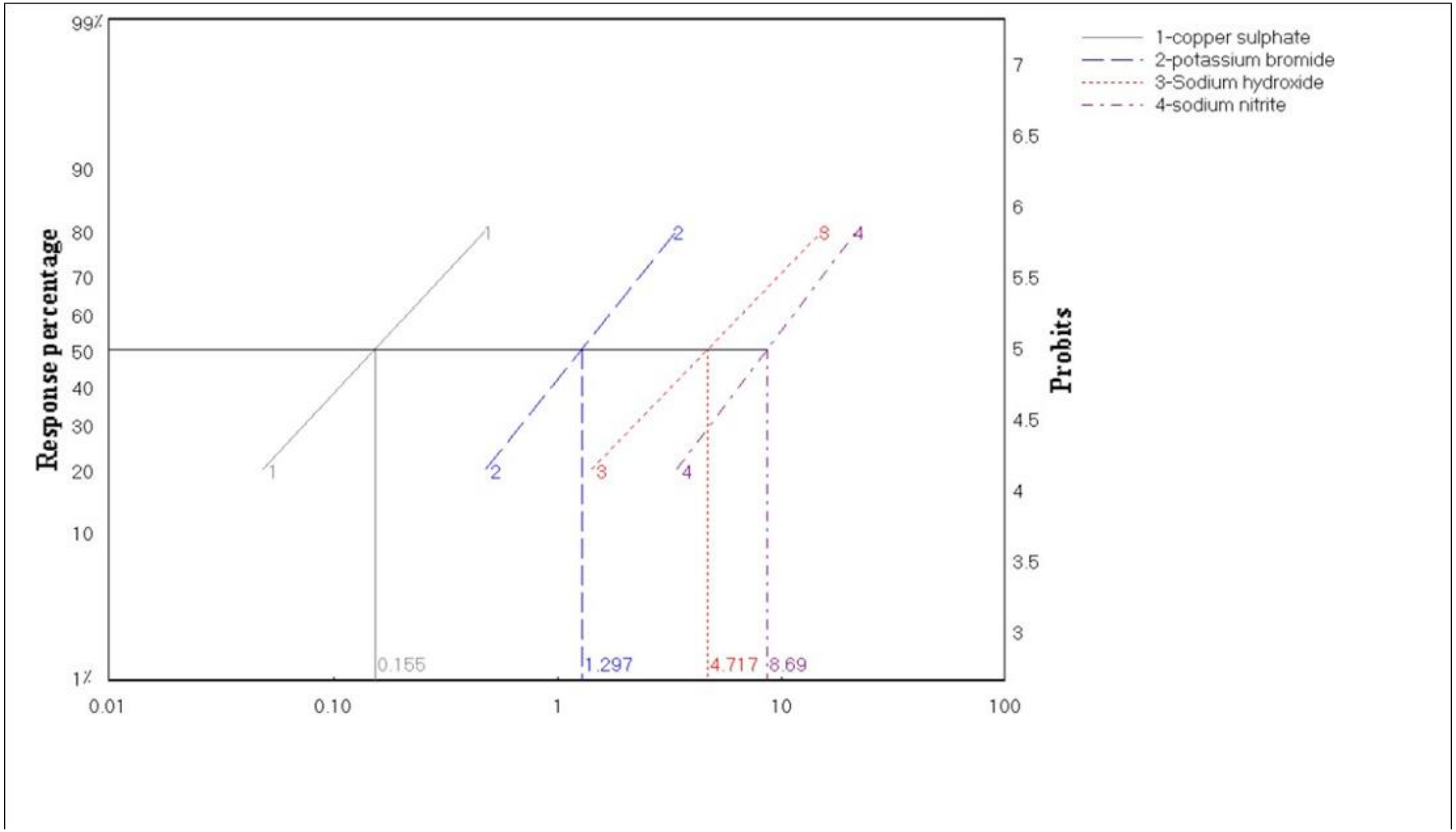

Fig. 1. L.d.p. lines of four inorganic salts on laboratory of *Monacha obstructa*

Table 2. Effect of four inorganic salts against terrestrial snail, *E. vermiculata,* after treatment

		Eobania vermiculata			
Salts	**Concentration (%)**	**Mortality (%)**	**LC_{50} (%)**	**LC_{90}**	**Slope+/-SE**
Sodium hydroxide	1.56	13.33	4.6985	19.3519	2.0847+/- 0.2159
	3.125	40			
	6.25	60			
	12.5	80			
Sodium nitrite	2	13.33	9.5608	40.3541	2.0493+/- 0.1951
	5	20			
	10	46.67			
	15	66.67			
	20	80			
Potassium bromide	0.195	6.66	2.0149	12.037	1.6510+/- 0.1690
	0.39	6.66			
	0.78	26.66			
	1.56	46.66			
	3.125	60			
Copper sulfate	0.0625	20	0.1757	0.6901	2.1568+/- 0.2182
	0.125	33.33			
	0.25	60			
	0.5	86.67			

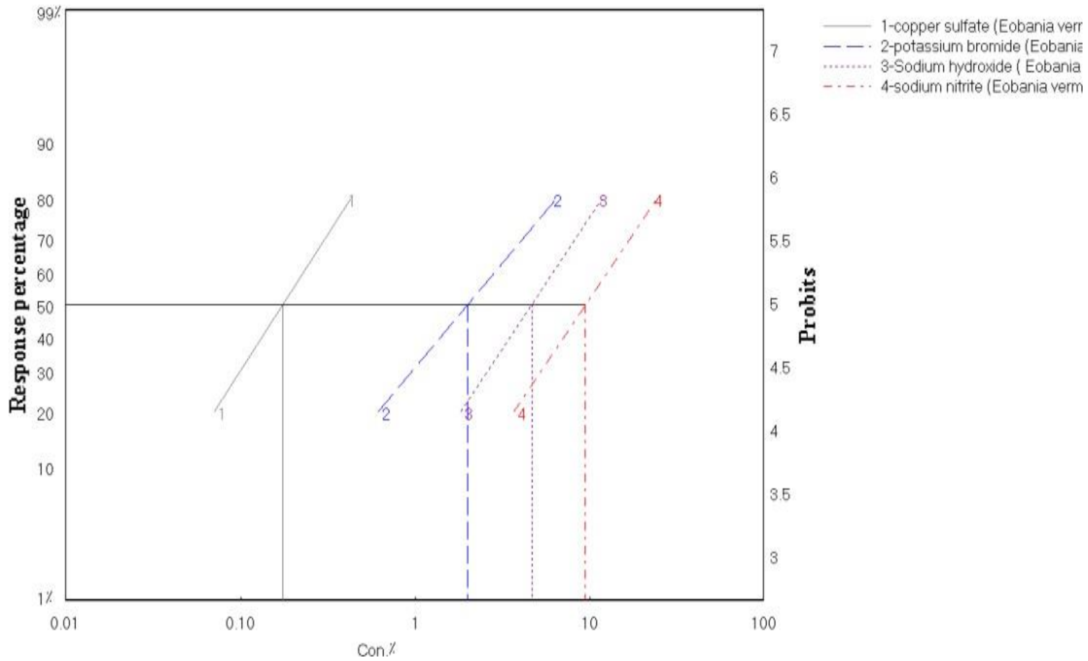

Fig. 2. L.d.p. lines of four inorganic salts on laboratory of *Eobania vermiculata*

Table 3. Toxicity index values of the tested four inorganic salts against land snails, *M. obstructa*

Inorganic salts	LC_{50}%	LC_{90}%	Toxicit index based on	
			LC_{50}	LC_{90}
Sodium hydroxide	4.7173	28.6236	3.28	3.09
sodium nitrite	8.69	35.4697	1.78	2.49
potassium bromide	1.2966	5.7474	11.94	15.37
copper sulphate	0.1548	0.8834	100	100

$$Toxicity\ index\ = \frac{LC50\ of\ most\ effective\ compound}{LC50 of\ other\ tested\ compound} x\ 100$$

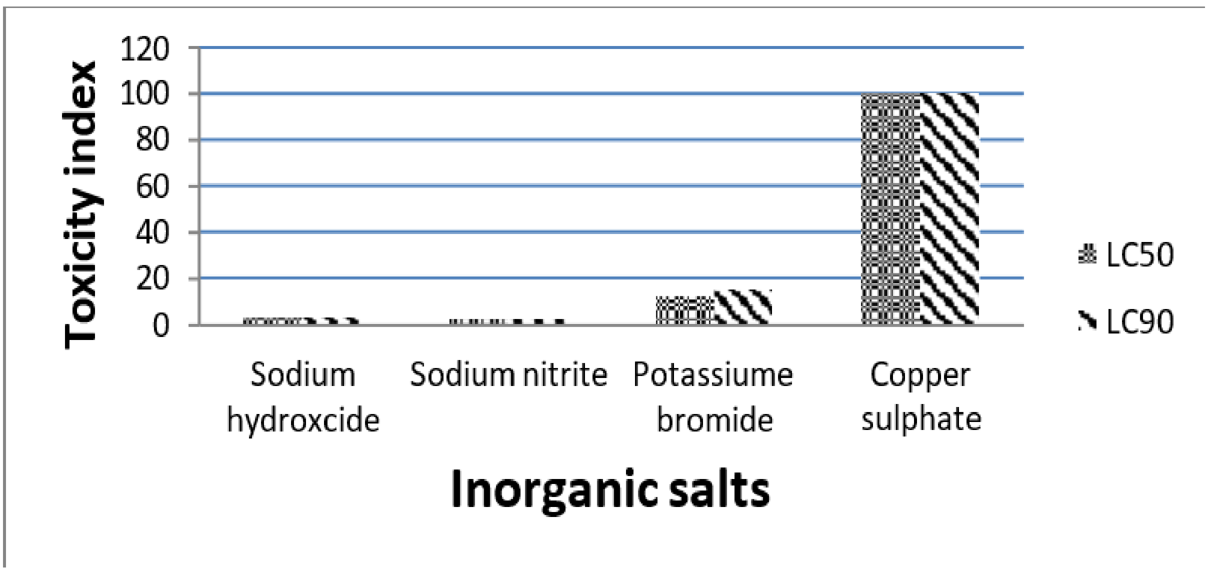

Fig. 3. Toxicity index values of the tested four inorganic salts against land snails, *M. obstructa*

Table 4. Toxicity index values of the tested four inorganic salts against land snails, *E. vermiculata*

Inorganic salts	LC_{50}%	LC_{90}%	Toxicity index based on	
			LC_{50}	LC_{90}
Sodium hydroxide	4.6985	19.3519	3.739	3.567
sodium nitrite	9.5608	40.3541	1.838	1.710
potassium bromide	2.0149	12.037	8.720	5.733
copper sulphate	0.1757	0.6901	100	100

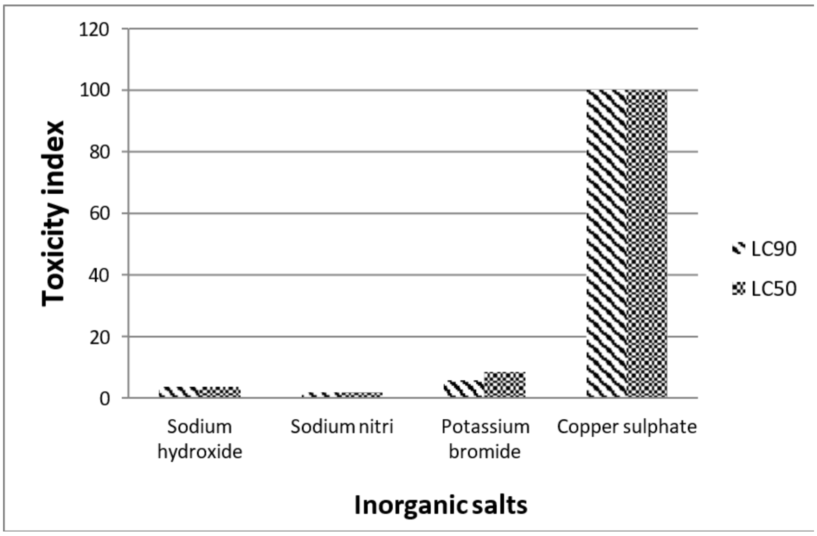

Fig. 4. Toxicity index values of the tested four inorganic salts against land snails, *E. vermiculata*

Table 5. Slope, LC_{90}/ LC_{50} and relative potency levels of the tested inorganic salts against land snails, *M. obstructa*

Inorganic salts	Slope	LC_{50} (%)	LC_{90} (%)	LC_{90}/ LC_{50}	Relative potency levels based on	
					LC_{50}	LC_{90}
Sodium hydroxide	1.6367	4.7173	28.6236	6.068	1.842	1.239
sodium nitrite	2.0981	8.69	35.4697	4.082	1.00	1.00
potassium bromide	1.9819	1.2966	5.7474	4.32	6.702	6.171
copper sulphate	1.6941	0.1548	0.8834	5.706	9.837	20.937

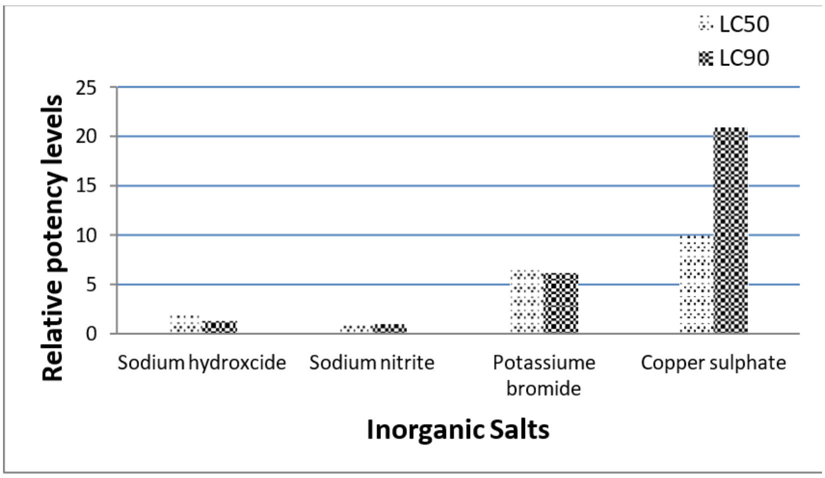

Fig. 5. Relative potency levels of the tested inorganic salts against land snails, *M. obstructa*

Table 6. Slope, LC_{90}/ LC_{50} and relative potency levels of the tested inorganic salts against land snails, *E. vermiculata*

Inorganic salts	Slope	LC_{50} (%)	LC_{90} (%)	LC_{90}/ LC_{50}	Relative potency levels based on	
					LC_{50}	LC_{90}
Sodium hydroxide	2.084	4.698	19.351	4.119	2.035	2.085
sodium nitrite	2.049	9.560	40.354	4.221	1.000	1.000
potassium bromide	1.551	2.014	12.037	5.977	4.747	3.352
copper sulphate	2.156	0.175	0.690	3.943	54.629	58.484

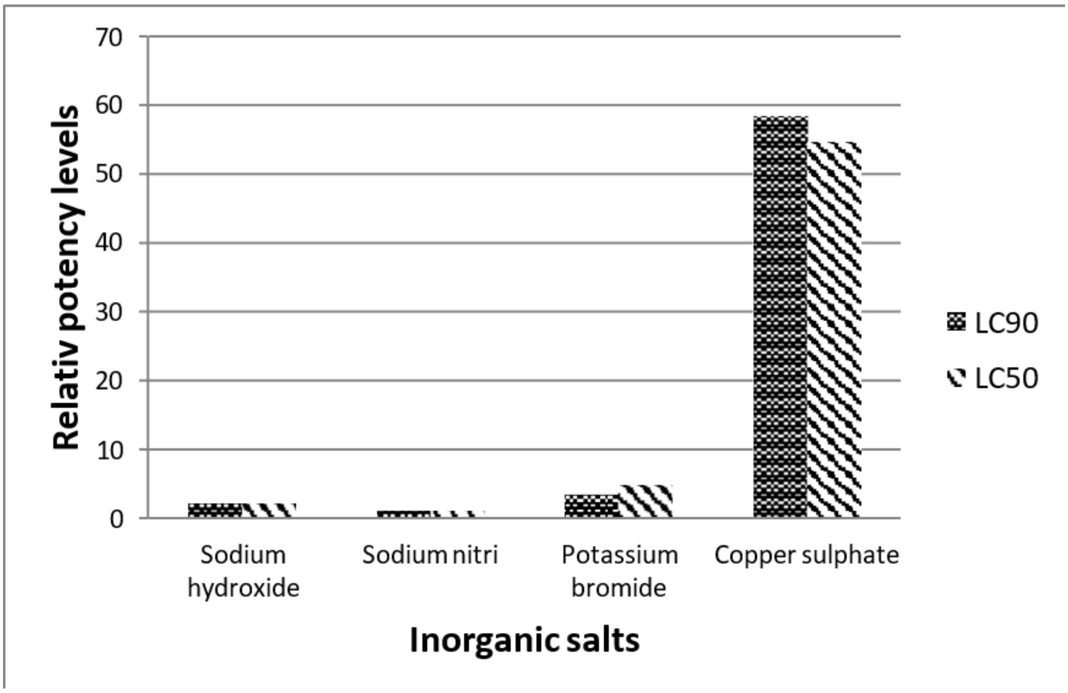

Fig. 6. Relative potency levels of the tested inorganic salts against land snails, *E. vermiculata*

2.049 and 1.551; respectively. Data presented in Table (6) and illustrated in Fig. (6) demonstrated that sodium nitrite the lowest toxic compound was chosen as a standard product at both LC_{50} and LC_{90} levels. It was obvious that the relative toxicity of sodium hydroxide, potassium bromide and copper sulfate at LC_{50} and LC_{90} levels were 2.035 & 2.085 ,4.747 &3.352 and 54.629 & 58.484 times as toxic as the toxicity of sodium nitrite against land snails, *E. vermiculata*; respectively.

3.6 Effect of four Inorganic salts on Land Snail Productivity

To study the effect of four inorganic salts on land snail fecundity or egg productivity, thirty health individuals of both *Eobania vermiculata* and *Monacha obstructa* treated with low concentrations of sodium hydroxide, sodium nitrate, potassium bromide, and copper sulfate were separately collected and compared with the untreated survival snails. Results indicated that, the laid eggs of treated terrestrial snails of *E. vermiculata* and *M. obstructa* were nil (Table, 7).

$$Hatchability\,\% = \frac{No.of\ hatching\ in\ one\ mass}{No.of\ egg\ in\ one\ mass} x\ 100$$

3.7 Field Studies

The field performance of the two tested inorganic salts (sodium nitrite and copper sulfate) against *Eobania vermiculata* and *Monacha. obstructa* population is shown in Tables (8&9). The two tested inorganic salts were more effective against the two species of land snails (*E. verniculata* and *M. obstructa*). Results revealed that sodium nitrate and copper sulfate, after 15 days of treatment, caused 77.06, 85.315% reduction in population of *E. vermiculata* and 85.315, 77.51% reduction in population of *M. obstructa*, respectively.

Table 7. Egg production and hatchability of *Eobania vermiculata and Monacha obstructa* treated with sodium hydroxide and sodium nitrate, potassium bromide and copper sulfate. in comparison with healthy untreated snails

	Eobania vermiculata				*Monacha obstructa*			
Tested compound	**No, of egg masses/ Snail**	**No. of eggs/ mass**	**No of hatching**	**Hatchability %**	**No, of egg masses/ Snail**	**No. of eggs/ mass**	**No of hatching**	**Hatchability %**
Control	**6**	**72.33**	**66.33**	**91.71**	**5**	**95.2**	**91.6**	**96.22**
Sodium hydroxide	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Sodium nitrite	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Potassium bromide	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Copper sulfate	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Table 8. Field Performance of two inorganic salts against terrestrial snail, *Eobania vermiculata,* after 15 days of treatment

Tested compound	**Concentration**	**No. of snails before treatment**	**No. of live snails after treatment**	**Population reduction%**
Control	-	170	115	-
sodium nitrite	200g/L	116	18	77.06
copper sulfate	5g/L	151	15	85.315

Table 9. Field Performance of two inorganic salts against land snail, *Monacha obstructa,* after 15 days of treatment

Tested compound	**Concentration**	**No. of snails before treatment**	**No. of live snails after treatment**	**Population reduction%**
Control	-	68	56	
sodium nitrite	200g/L	45	8	85.315
copper sulfate	5g/L	54	10	77.51

4. DISCUSSION

4.1 Laboratory Tests

The obtained results indicated a rise in mortality rates corresponding to higher concentrations of the tested salts. Among these, sodium hydroxide and copper sulfate demonstrated a highly toxic impact on the land snails, *Eobania vermiculata* compared to the land snail *Monacha obstructa*, and sodium nitrite, potassium bromide highly toxic for *Monacha obstructa* compared to *Eobania vermiculata*. It was noticeable that inorganic salts extended a highly toxic effect after a time of treatment. This result may be due to that inorganic salts take a long time to arrive the target or site of action in the land snails' body. Corrao Norah et al. (2006) reported that 500 ppm of nitrite gave low mortality against land snail till 4 days after treatment. Hegab *et al*. (2013) studied the toxic effect of copper sulphate against *Eobania vermiculata* and found that the compound caused 65, 70, 80, and 85% mortality at 1, 3, 5, and 7% concentrations respec- tively, after seven days of treatment. Ismail *et al*. (2010) said that the copper hydroxide had a low effect on the land snali *Monacha cartusiana* under laboratory and field conditions. Chauhan *et al*. (2011) said that the plant extract Lantana indica caused a reduction in fertility and hatchability of the water snail *Lymnaea acuminata* at concentrations of 20 and 40% concentrations. The land snail egg production was reduced compared with control snails after 15 days of treatment with nitrite, (Cofone *et al*., 2020**).** El-Sabagh *et al*. (2015) observed that inorganic salts such as NaOH, Ca(OH)2, and CuSO4 achieved 100% sterility in cotton leaf worms (*Spodoptera littoralis*), inducing abnormalities during the pupal stage. Similarly, Goddard and Martin (1966) found that treatment with embactin benzoate significantly reduced the hatching rate of new snails. Adewunmi *et al*. (1987) reported a decline in glycogen and protein levels leading to reduced egg production in *Biomphalaria glabrata* and *Lymnaea columella*. The two tested inorganic salts demonstrated effective results against land snails*, Eobania vermiculata* and *Monacha. Obstructa*.

4.2 Field Studies

Abbas Nada (2020) reported that embactin benzoate and chitosan achieved population reductions of 66.6% and 74.3%, respectively, in snails under field conditions. Similarly, Eshra *et al*. (2016) investigated the effect of NPK fertilizer on land snails, specifically *Monacha obstructa*, under field conditions, observing a 66.8% reduction in population after seven days of treatment.

5. CONCLUSION

The tested inorganic salts exhibit a highly toxic effect on the terrestrial snails, *Monacha obstructa* and *Eobania vermiculata*. Under laboratory conditions, these salts not only led to the death of many treated snails but also diminished their ability to egg production. Given these striking effects, it seems appropriate to suggest their inclusion in land snail management strategies within Egyptian agricultural land. Nevertheless, it's essential to emphasize that further investigations are warranted to explore how these inorganic salts effect on soil and various other environmental components.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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