J. Plant Prot. and Path., Mansoura Univ., Vol.8 (4), 189 – 194, 2017

Comparison among the Toxicity of Thymol and Certain Pesticides on Adults Survival and Egg Hatchability of the Glassy Clover Snail *Monacha cartusiana* (MÜLLER)

Mona A. Ali
Plant Protection Research Institute, Agric. Res. Center, Dokki, Giza, Egypt

This article was CHECKED against plagiarism using TurnitIn software

ABSTRACT

Land gastropods have become important economic pests attacking various vegetation in Egypt. This study aimed to determine the molluscicidal activity of the monoterpenoids compound, Thymol and three pesticides (Neomyl, Kafrothrin and Round up) against adult's survival and egg hatchability of the glassy clover snail *Monacha cartusiana* under laboratory and field conditions. Poisonous baits technique gave better results than did leaf dipping technique. The obtained results indicated that Neomyl was the most effective one followed by Thymol and Kafrothrin then Round up which had the lowest affect against the adult of *M. cartusiana* with LC50 0.79, 1.78, 3.62 and 0.49 ppm respectively. Also, Neomyl was the most effective one on the incubation period of eggs of *M. cartusiana* (25 days in average) followed by Thymol (23.5 days in average), Kafrothrin (23 days in average) and Round up (22 days in average). Similar trend was noticed with mean egg hatchability with values of 1.0, 1.8, 3.0 and 4.4, respectively. In field experiment represented using poisonous baits of such compounds Neomyl (72.61%) gave the highest reduction percentage in Egyptian clover fields naturally infested with *M. cartusiana* followed by Thymol (55.82%) and Kafrothrin (50.03%) then Round up (17.20%). The obtained results proved that the use of Thymol in controlling harmful land snail would achieve effectiveness comparable to synthetic molluscicides.

Keywords: Land snails, *Monacha cartusiana,* Thymol, pesticides.

INTRODUCTION

Terrestrial molluscs are considered a significant threat to sustainable agriculture in many parts of the world (Barker, 2002). They are major pests of a wide range of agricultural and horticultural crops in temperate and humid habitats worldwide (Speiser and Kistler, 2002). Economic damage caused by these molluscs is due to feeding and contamination with their bodies, feces or slime, leading to deterioration of the product quality, in addition to the financial loss (Iglesias *et al*., 2003). The glassy clover snail, *Monacha cartusiana* (Müller) causes damage to vegetables and field crops (El-Deeb *et al*., 2003).

Molluscicides of plant origin are natural products and are ecologically preferable than synthetic ones (Kumar *et al.*, 2012). Plant – derived products have been suggested as alternatives for pest control. Particularly, monoterpenoids have been recently used for the purpose of pest control as insecticides (Rice and Coats 1994) and molluscicides (Powell and Bowen 1996). Thymol is a monoterpenoid plant substance obtained from the essential oil of Laminacea species. It is a part of naturally occurring class of compounds known as biocides. It acts as a bactericide, fungicide and has antimicrobial activity because of its phenolic structure (Wicht *et al*., 2004).

Therefore, this study was carried out to compare the effect of Thymol as active ingredient with certain pesticides on adult's mortality and egg hatchability of the glassy clover snail, *Monacha cartusiana* under laboratory and field conditions.

MATERIALS AND METHODS

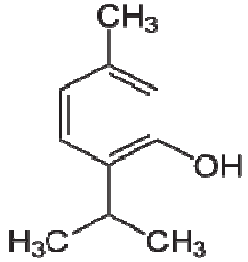
Experimental snails:

Adults of the land snail *Monacha cartusiana* were handily collected from infested fields at Al Khayariyah village, Mansoura district, Dakahlia Governorate. The obtained snails were transferred to the laboratory and then kept in plastic containers filled with moist sterilized sandy loamy soil at 25 C° ± 2 C° and 75 % ± 5 % soil moisture. Snails were fed on fresh leaves of lettuce (*Lactuca sativa L.*) for 14 days to be laboratory acclimatized. Dead and unhealthy snails were removed and only healthy ones were used in the experiments.

Tested Compounds:

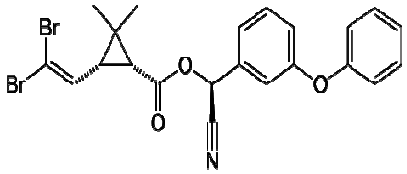
1-Thymol is monoterpenoid compound and white crystalline substance of a pleasant aromatic odor.
Chemical name: 5-methyl-2-(1-methyl-ethyl) phenol.
The structure formula: ($C_{10}H_{14}O$).

Thymol was obtained from El- Gomhoria company- Mansoura with purity 99.5%.



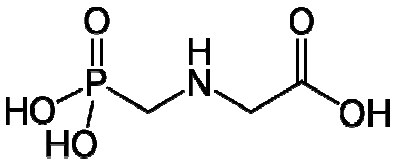
Chemical structure of Thymol

2- Deltamethrin:(Kafrothrin2.5%EC)Pyrethroid ester insecticide.
Chemical name:[(S)-cyano-(3-phenoxyphenyl)methyl] (1R,3R)-3-(2,2-dibromoethenyl)-2,2-dimethylcyclopropane -1-carboxylate
The structure formula: ($C_{22}H_{19}Br_2NO_3$)



Chemical structure of Deltamethrin

3-Glyphosate:(Round up 48 % SL)Organophosphorous herbicide
Chemical name: (N- (Phosphonomethyl) glycine.
The structure formula: ($C_3H_8NO_5P$).

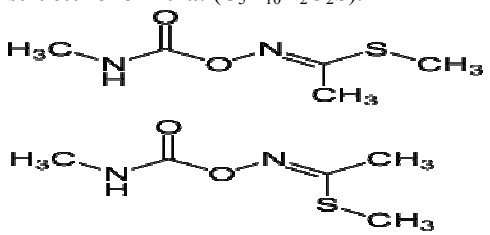


Chemical structure of Glyphosate

4-Methomyl:(Neomyl 20 % SL) Carbamate insecticide.

Chemical name: S-methyl N (methylcarbamoyloxy) thioacetimidate.

The structure formula: ($C_5H_{10}N_2O_2S$).



Chemical structure of Methomyl

Laboratory experiments:-

1- Leaf- dipping technique:

Four concentrations of Thymol, Kafrothrin, Round up and Neomyl were used. For each concentration fresh lettuce leaves were dipped for one minute and left for dryness (Ghamry, 1994). The treated leaves were placed inside plastic boxes filled with moist sterilized sandy loamy soil. Ten adult snails of *M. cartusiana* were placed into each box. Each box was covered with muslin cloth fixed with rubber bands to prevent snails from escaping. Each concentration had three replicates and untreated lettuce disks were used as a control treatment. Mortality percentage was recorded after 1, 3, 5 and 7 days post treatments.

2- Poisonous baits technique:

Three concentrations (1, 2 and 4%) were prepared for each compound. Baits were prepared by incorporating the appropriate amount of each compound and added 5 parts of sugar cane syrup then completed with wheat bran to give 100 parts from baits (El-Okda, 1981). Control treatment was prepared using bran bait free from any compound. Five grams of each poison bait were spread into each box filled with moist sterilized sandy loamy soil. Ten adults of *M. cartusiana* snails were introduced and then tightly covered with muslin clothes netting and secured with rubber band to prevent snail from escaping. All tested compounds and control were replicated three times. The tested snails were examined daily, where the dead individuals were counted and removed. Mortality percentage was recorded after 1, 3, 5, 7 days post treatment.

Toxicity of the tested compounds:

1- Mortality percentages were corrected according to Abbott's formula (Abbott, 1925). LC_{50} values were determined using probit analysis statistical method of Finney (1971).

2- Toxicity index of the tested compounds was determined according to Sun equation (Sun, 1950) as follows:

$$\text{Toxicity index } (LC_{50}) = \frac{LC_{50} \text{ of the most effective compound}}{LC_{50} \text{ of the least effective compound}} \times 100$$

Effect of Thymol and three pesticides on incubation period and hatchability percentages of *Monacha cartusiana*:

Adult land snail, *M. cartusiana* was put in cultural box. The soil was examined daily to search new clutches of eggs. Newly deposited clutches were collected by a fine hair brush. The eggs were divided into batches of 20 eggs. Each batch of eggs (up to 24 h old) was placed in a culture dish containing 5 g of sterile moist soil. One ml of each compound solution (LC_{50}) was topically applied directly on egg batches. All tested compounds and control groups were replicated five times and distilled water were used as a control treatment. The eggs were examined daily for a period of one month to record the date of hatching and incubation period. Percentage of egg hatchability was calculated and recorded.

Field experiment:

The tested compounds were applied in a field cultivated with Egyptian clover highly infested with *M. cartusiana* at Al Khayariyah village, Mansoura district, Dakahlia Governorate. The tested compounds were applied as poisonous wheat bran baits at the concentration of 2% for each compound. The applied concentration was prepared by incorporation of the tested toxicant into bait formulation consisted of sugar cane syrup and wheat bran (2 parts toxicant + 5 parts of sugar cane syrup + 93 parts of wheat bran). Each treatment was replicated three times and the control treatment was designed by the same manner without any toxicant. Baits were offered on plastic pieces each one about 100 gm. Alive snail was recorded in check and treatment areas before application and after 1, 3, 7, 14 and 21 days until the end of the experiment. Reduction percentages of *M. cartusiana* were calculated according the formula of Henderson and Tilton (1955) as follow:

$$\% \text{ Reduction} = 100 [1 - t2\ r1/t1r2]$$

where:

r1 = number of alive snails before treatment in untreated plots.

r2 = number of alive snails after treatment in untreated plots.

t1 = number of alive snails before treatment in treated plots.

t2 = number of alive snails after treatment in treated plots.

RESULTS AND DISCUSSION

1-Comparison among the toxicity of Thymol and certain pesticides towards *Monacha cartusiana* adult snail using leaf dipping technique under laboratory conditions:

Data presented in Table (1) indicated that Neomyl caused high mortality percentage for *M. cartusiana* adult snails followed by Kafrothrin and Thymol then Round up. However, the toxicity of such compounds was increased with increasing the concentration. At higher concentration, the greatest percentage in adult's mortality was recorded one day post treatment.

As shown in Table (2) and Fig (1) LC_{50} and LC_{90} values were 12360.0, 1095.9, 17688.7 and 834.9 ppm and 54403.1, 8232.7, 49621.1 and 7388.8 ppm for Thymol, Kafrothrin, Round up and Neomyl, respectively.

Table 1. Mortality percentages of *Monacha cartusiana* adult snails after the exposure to different concentrations of Thymol and three pesticides using leaf dipping technique under laboratory conditions.

Treatments	Conc. (ppm)	Mortality after treatments %				Total Mortality %
		One day	Three days	Five days	Seven days	
Thymol	5000	0.00	6.67	3.33	16.67	26.67
	10000	10.00	0.00	10.00	13.33	33.33
	15000	23.33	10.00	6.67	13.33	53.33
	20000	26.66	26.66	0.00	20.00	73.32
Kafrothrin	500	6.66	10.00	3.33	6.66	26.65
	1000	13.33	26.66	6.67	6.67	53.33
	2000	23.33	30.00	0.00	13.33	66.66
	4000	36.66	20.00	20.00	0.00	76.66
Round up	10000	0.00	3.33	13.33	6.66	23.32
	12000	0.00	10.00	10.00	13.33	33.33
	15000	6.66	13.33	3.33	16.66	39.98
	20000	20.00	16.67	10.00	10.00	56.67
Neomyl	1000	23.33	16.66	10.00	6.66	56.65
	2000	30.00	26.66	3.33	6.67	66.66
	3000	33.33	26.66	0.00	13.33	73.32
	4000	40.00	33.33	10.00	3.33	86.66

Table 2. Molluscicidal activity (LC_{50} and LC_{90}) of Thymol and three pesticides against glass clover snail, *Monacha cartusiana* using leaf dipping technique under laboratory conditions.

Treatments	Conc.	Corrected mortality%	LC_{50}	LC_{90}	Slope± S.E.	Toxicity index LC_{50}	LC_{90}/LC_{50}	R	P
Thymol	5000	26.67	12360.0	54403.1	1.99± 0.54	6.76	4.40	0.92	0.31
	10000	33.33							
	15000	53.33							
	20000	73.33							
Kafrothrin	500	26.65	1095.9	8232.7	1.46± 0.36	76.19	7.51	0.97	0.66
	1000	53.33							
	2000	66.64							
	4000	76.66							
Round up	10000	23.32	17688.7	49621.1	2.86± 1.06	4.72	2.81	0.99	0.95
	12000	33.3							
	15000	39.98							
	20000	56.67							
Neomyl	1000	56.65	834.9	7388.8	1.35± 0.53	100.00	8.85	0.93	0.64
	2000	66.66							
	3000	73.32							
	4000	86.66							

LC_{50} = Lethal concentration that kills 50% of exposed snails.
LC_{90} = Lethal concentration that kills 90% of exposed snails.
S.E. = Standard Error.
R: Regression
P: Probability

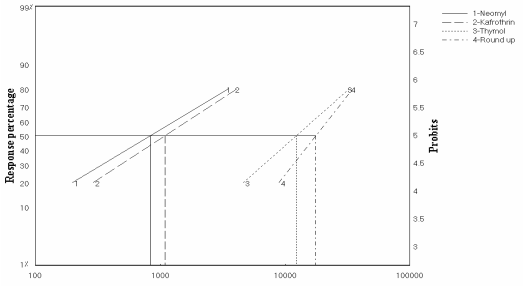


Fig. 1. Con/probit regression line of tested compounds on *Monacha cartusiana* snail.

2-Comparison among toxicity of Thymol and certain pesticides towards *Monacha cartusiana* adult snail using poisonous baits technique under laboratory conditions:

Data presented in Table (3) indicated that Neomyl induced high mortality percentage of *M. cartusiana* adults followed by Thymol and Kafrothrin then Round up.

As presented in Table (4) and Fig (2) LC_{50} and LC_{90} values were 0.79, 1.78, 3.62 and 0.49 ppm and 5.09, 23.98, 24.48 and 2.08 ppm for Thymol, Kafrothrin, Round up and Neomyl respectively. It is clear that Neomyl belonging to carbamates was the most potent one followed by Thymol (monoterpenoids compound) or Kafrothrin (pyrethroid) then Round up (organophosphorous) against *M. cartusiana* adults using leaf dipping and poisonious baits techniques. However, poisonous baits technique showed better results than did leaf dipping technique. These results agreed with (Young and Wilkins, 1989) who reported that Carbamate molluscicides act as nerve toxins by inhibition of cholinesterase. Also, pyrethroids (Kafrothrin) act on tiny channels through which sodium is pumped to cause excitation of neurons. They prevent the sodium channels from closing, resulting in continual

nerve impulse transmission, tremors, and eventually, death (Brown, 2006). Also, these results are in agreement with those reported by Aioub *et al.,* (2000) who revealed that carbamate compounds appeared to the most highly toxic while organophosphorous was the least toxic ants under laboratory conditions. Also, Genena and Mostafa (2008) found that deltamethrin (Kafrothrin) belonging to pyrethroid group showed high initial toxicity of 70.0% against *M. cantiana* after three days of exposure. However, methomyl belonging to carbamate group gave 100.0% mortality after seven and 12 days for *M. cantiana*. El-Zemity and Radwan (2001) showed that, the molluscicidal activity of major constituents of some essential oils including thymol and other monoterpenoids i.e. carveol, eugenol exhibited high molluscicidal activity against *T. pisana* and *H. aspersa* snails. Also, Beltagi, *et al* (2010) found that Thymol was the most promising compound, showing molluscicidal activity (LD_{50} 551.20µg/snail) against the brown garden snail, *Eobania vermiculata* using the topical application method. Godan (1983) mentioned that herbicides not only kill weeds but also molluscs either through the animal skin or by ingestion through the intestine.

Table 3. Mortality percentages of *Monacha cartusiana* adult snails after the exposure to different concentrations of Thymol and three pesticides using poisonous baits technique under laboratory conditions.

Treatments	Conc. (%)	Mortality after treatments %				Total Mortality %
		One day	Three days	Five days	Seven days	
Thymol	1	0.00	13.33	20.00	26.67	60.00
	2	16.67	23.32	26.67	0.00	66.66
	4	20.00	33.33	0.00	36.60	89.93
Kafrothrin	1	10.00	13.33	6.66	10.00	39.99
	2	13.33	16.67	16.67	3.33	50.00
	4	16.66	20.00	30.00	0.00	66.66
Round up	1	3.33	10.00	0.00	6.67	20.00
	2	6.67	3.33	10.00	13.30	33.30
	4	10.00	16.66	20.00	6.67	53.33
Neomyl	1	13.33	13.33	16.67	30.00	73.33
	2	13.33	26.66	33.33	16.67	89.99
	4	33.33	43.33	0.00	20.00	96.66

Table 4. Molluscicidal activity (LC_{50} and LC_{90}) of Thymol and three pesticides against the glassy clover snail *Monacha cartusiana* using poisonous baits technique under laboratory conditions.

Treatments	Conc.	Corrected mortality%	LC_{50}	LC_{90}	Slope± S.E.	Toxicity index LC_{50}	LC_{90}/ LC_{50}	R	P
Thymol	1	60.00	0.79	5.09	1.59± 0.61	61.61	6.38	0.94	0.27
	2	66.66							
	4	89.93							
Kafrothrin	1	39.99	1.78	23.98	1.13± 0.55	27.63	13.50	0.99	0.75
	2	50.00							
	4	66.66							
Round up	1	20.00	3.62	24.48	1.54± 0.58	13.58	6.77	0.99	0.86
	2	33.30							
	4	53.33							
Neomyl	1	73.33	0.49	2.08	2.05± 0.80	100.00	4.23	0.998	0.89
	2	89.99							
	4	96.66							

LC_{50} = Lethal concentration that kills 50% of exposed snails.
LC_{90} = Lethal concentration that kills 90% of exposed snails.
S.E. = Standard Error.
R: Regression
P: Probability

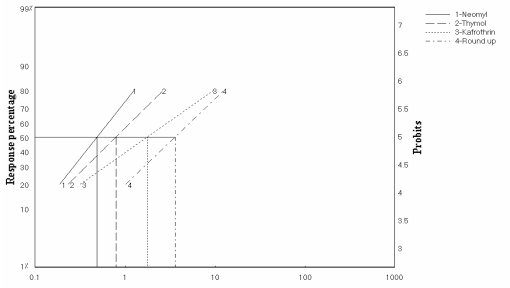


Fig. 2. Con/probit regression line of tested compounds on *Monacha cartusiana* snail.

Effect of Thymol and three pesticides on egg hatchability of *Monacha cartusiana*:

The hatchability of *M. cartusiana* eggs treated with Thymol, Kafrothrin, Round up and Neomyl is shown in Table (5). Results showed that Neomyl (1.0) recorded the highest mean reduction in number of hatched eggs followed by Thymol (1.8) and Kafrothrin (3.0) then Round up (4.4) compared to control (18.0). Similar trend was noticed with rate of hatchability with values of 0.06, 0.10, 0.17 and 0.24 for Neomyl, Thymol, Kafrothrin and Round up respectively. El- Massry (1997) found that all concentrations of the tested pesticides i.e methamidophos. malathion and chloropyrifos methyl significantly decreased the percentages of eggs hatchability of *Helicella vestalis* snails. Ferreira *et al.* (2011) found that Thymol had ovicidal activity (98%) against *Subulina octona* eggs. However, eggs treated with Thymol at 5 and 2.5 g/L did not hatch. Hence, Thymol could also be used to control the snails by inactivating their eggs, since these animals have a large reproductive capacity and some of the products in use manage to affect the snail, but not their eggs. Shoaib *et al.* (2009) found that LC_{50} of Nimbecidine ® (containing azadirachtin 0.03%) for the treated eggs was 2.18 ml/ L and eggs failed to hatch at concentration of 10 ml/L, which caused 100% mortality of eggs. From the previous results we can concluded that Neomyl was the most effective one on egg hatchability of *M. cartusiana* followed by Thymol and Kafrothrin then Round up which recorded the lowest effective one.

Table 5. Effect of Thymol and three pesticides on egg hatchability of the glassy clover snail, *Monacha cartusiana*

Treatments	Aver. no. of exposed eggs	Aver. no. of hatched eggs	Rate of hatchability	Egg hatchability (mean ± SE)
Thymol	20	1.8	0.10	1.8 ± 0.80 [bc]
Kafrothrin	20	3.0	0.17	3.0 ± 1.38 [bc]
Round up	20	4.4	0.24	4.4 ± 1.57 [b]
Neomyl	20	1.0	0.06	1.0 ± 0.55 [c]
Control	20	18.0	1.00	18.0 ± 0.95 [a]

Each value represented mean of five replicates.

Rate of hatchability = No. of hatched eggs (treated group) / No. of hatched eggs (control group)

S.E. = Standard Error.

Effect of Thymol and three pesticides on the incubation period of *Monacha cartusiana* eggs:

Results in Table (6) clearly indicated that incubation period *M. cartusiana* eggs treated with Thymol, Kafrothrin, Round up and Neomyl ranged between 21 and 26; 19 and 27 days; 19 and 25 days and 23 and 27 days respectively. Also, data proceeded that Neomyl was the most effective one on the incubation period of *M. cartusiana* eggs (25 days in average) followed by Thymol (23.5 days in average), Kafrothrin (23 days in average) and Round up (22 days in average) compared to control (20 days in average).

Table 6. Effect of Thymol and three pesticides on the incubation period of *Monacha cartusiana* eggs.

Treatments	Aver. No. of hatched eggs after ……. (days)											Range (in days)		Mean
	17	18	19	20	21	22	23	24	25	26	27days	Min	Max	
Thymol	-	-	-	-	0.4	0.4	1.2	1.2	1.4	1.8	1.8	21	26	23.5
Kafrothrin	-	-	0.2	0.4	0.6	1.2	1.4	2.0	2.0	2.6	3.0	19	27	23
Round up	-	-	0.2	0.2	0.6	8.0	1.6	3.4	4.4	4.4	4.4	19	25	22
Neomyl	-	-	-	-	-	-	0.2	0.4	0.4	0.6	1.0	23	27	25
Control	3	5	8	10	13	14	18	18	18	18	18	17	23	20

Each value represented mean of five replicates.

Efficiency of Thymol comparing with three pesticides used as poisonous baits against the glassy clover snail *Monacha cartusiana* infesting Egyptian clover under field conditions:

Data presented in Table (7) showed the reduction percentage values of *M. cartusiana* snail exposed to Thymol, Kafrothrin, Round up and Neomyl using poisonous baits technique. Data showed that the percentages of snail's reduction after the first three days of treatment were 52.32, 45.13, 18.94 and 66.86 % for Thymol, Kafrothrin, Round up and Neomyl, respectively. The residual effects of these compounds were 59.31, 54.93, 15.45 and 78.35% reduction, consequently with averages of 55.82, 50.03, 17.20 and 72.61% reduction for Thymol, Kafrothrin, Round up and Neomyl, respectively. The most effective one was Neomyl followed by Thymol and Kafrothrin then Round up. The current data agreed with Ismail *et al.* (2005) who mentioned that methomyl (Neomyl) showed the highest residual effect against *M. cartusiana* snails under field conditions. Samy *et al.* (2015) reported that Neomyl was the most potent compound in reducing the population density of *Monacha* spp. in lettuce and cabbage fields. Ismail *et al.* (2015) reported that poisonous baits technique was more effective than spray technique in controlling *M. cartusiana* snail under field conditions

Table 7. Reduction percentage of *Monacha cartusiana* snails infesting Egyptian clover following the addition of Thymol and three pesticides under field condition at Dakahlia Governorate.

Treatments	Reduction percentage after indicated days (%)							Mean of reduction %
	1	3	Initial kill	7	14	21	Residual effect	
Thymol	49.28	55.36	52.32	57.84	59.43	60.65	59.31	55,82
Kafrothrin	44.10	46.15	45.13	53.51	54.26	57.01	54.93	50.03
Round up	21.20	16.67	18.94	20.83	15.79	9.72	15.45	17.20
Neomyl	62.19	71.53	66.86	76.71	78.26	80.07	78.35	72.61

Initial kill = Mean percentage of reduction during the first and third days.
Residual effect = Mean percentage of reduction during the rest periods.

REFERENCES

Abbott, W.S. (1925): A method of computing the effectiveness of an insecticide. J.Econ. Entomol., 18: 265-267.

Aioub, A. A.; Sh. A.A. Ismail and A.A. Mohamdein (2000): Toxicological and histological studies on some pesticides-treated land snails. Proceeding of the first International Con. on Biological Science Faculty of Science Tanta Univ., 1 (2): 19:38

Barker, G.M. (2002): Molluscs as crop pests, 1st edition, CAB International

Beltagi, S. M.; S. M. Al-Shinnawy; N. R. Elkattan and H. Nady (2010): Effects of sublethal doses of selected botanical molluscicides on oxygen consumption of the brown garden snail, *Eobania vermiculata*. Egyp. J. Hosp. Med., 40: 402- 410.

Brown, A.E. (2006): Mode of action of structure pest control chemicals. Pesticide Information Leaflet, 41: 1-8.

El-Deeb, H. I.; Z. H. Zidan and M. M. Fouad (2003): Survey of terrestrial snails and their malacophagous insects at three governorates in Egypt. Egyp. Jour. Appl. Sci. 18: 355-361.

El- Massry, S.A. (1997): Studies on control of some land snails infesting certain fruit trees. Ph.D. Thesis, Fac. Of Agric., Zagazig Univ., 150 pp.

El-Okda, M.M. (1981): Response of two land molluscs to certain insecticides. Bull. Ent. Soc. Egypt Econ. Ser., 12: 53-57.

El-Zemity, S. R. and M. A. Radwan (2001): Molluscicidal and antifeedant activity of some essential oils and their major chemical constituents against *Theba pisana* snails. Arab Univ. J. Agric. Sci. Ain Shams Univ. Cairo, 9(1):483 – 493.

Ferreira, P. A.; L. G. S. Geraldo; Sthefane D'ávila and E. C. Bessa (2011): The influence of caffeine and thymol on the survival, growth and reproduction of *Subulina octona* (Brugüière, 1789) (Mollusca, Subulinidae). Brazilian. Arc. Bio. Techno., 52 (4): 945-952.

Finney, D. J. (1971): Probit analysis. Cambridge univ., London pp. 333.

Genena, Marwa A. M. and Fatma A. M. Mostafa (2008): Molluscicidal activity of six pesticides against the two land snails, *Monacha cantiana* and *Eobania vermiculata* (Gastropoda: Helicidae) under laboratory conditions. J. Agric. Sci. Mansoura Univ., 33: 5307-5315.

Ghamry, E. M. (1994): Local cruciferous seeds having toxic effect against certain land snails under laboratory conditions. Egypt, J. App. Sci., 9 (3): 632-640.

Godan, D., (1983): Pest slugs and snails, biology and control, Springer Verlag, Berlin.

Henderson, G. F. and Tilton, E. W. (1955): Test with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157- 161.

Iglesias, J.; J. Castillejo and R.Castro (2003): The effects of repeated applications of the molluscicide metaldehyde and the biocontrol nematode *Phasmarhabditis hermaphrodita* on mollusks, earth worms, nematodes, acarids and collembolans: a two-year study in north–west Spain. Pest Manag. Sci., 59: 1217-24.

Ismail, Sh.A . A; A. A. Abd- Allah; S. A. El- Masry, and A. M.Hegab, (2005): valuation of certain chemiclas and insecticides against *Monach cartusiana* snails infesting some vegetable crops at Skarkia Gvoernorate, J. Agric. Sci. Mansoura Univ., 30 (10): 6283- 6291.

Ismail, Sh. A. A.; S. Z. Shetaia, and M. M. Khattab (2015): Time of application as main factor affecting the efficacy of certain pesticides against land snail *Monacha cartusiana* under filed conditions at Sharkia governorate. J. Plant Prot. And Path., Mansoura. Univ., 5:(6):

Kumar, S.; N. Wahab; M. Mishra and R.Warikoo, (2012): Evaluation of 15 local plant species as larvicidal agents against an Indian strain of Dengue fever mosquito, *Aedes aegypti L*. (Diptera: Culicidae). Frontiers in Physiology, 3:104

Powell, A. and L.D. Bowen (1996): The screening of naturally occurring compounds for use as seed treatment for the protection of winter wheat against slug damage. In slug and snail pests in agriculture (ed. By Henderson, I.F.), British Crop Protection Council, BCPC Monograph 66: 231-236.

Rice, P.J. and J.R. Coats (1994): Insecticidal properties of several monoterpenoids to the house fly (Diptera: Muscidae), red flour beetle (Coleoptera: Tencbrionidea) and Southern corn rootworm (Coleoptera: Chrysomelidae) J. Ecom.Entomol., 87 (5): 1172- 1179.

Samy, M. A.; SK. M. Fakharany, and A. S. Hendawy (2015): Population fluctuation and host preference of land snail, *Monacha* spp and its control of biocides compared with neomyl. Fifth Intern. Comp. Plant Prot. Res. Inst. Hurgada. Egypt 3-9 May 2015. Sustainable Agricultural Development the Agricultural Production and the Challenges of Plant Protections.

Shoaib, M.A.; F.M. Mahmoud; N. Loutfy; M.A. Tawfic and M. Barta (2009): Effect of botanical insecticide Nembecidine® on food consumption and egg hatchability of terrestrial snail *Monacha obstructa*. J. Pest. Sci., Accepted 30 June 2009. Springer–Verlag 2009.

Speiser, B and C. Kistler (2002): Field tests with a molluscicide containing iron phosphate. Crop Protection, 21: 389-94.

Sun,Y.P. (1950): Toxicity index an improved method of comparing the relative toxicity of insecticides. J. Econ. Entomol., 43 : 45-53.

Wicht, M. J.; R. Haak; H. Schütt-Gerowitt; S. M.J. Kneist and Noack, (2004), Suppression of caries-related microorganisms in dentine lesions after short-term chlorhexidine or antibiotic treatment. Caries Res. 38: 436-441.

Young, A.G. and Wilkins, RM (1989): A new technique for accessing the contact toxicity of molluscicides to slugs. Journals of Molluscan Studies 53:533-536.

مقارنة بين التأثير السام لمركب الثيمول وبعض مبيدات الافات على حيوية الأطوار البالغة وفقس البيض لقوقع البرسيم الزجاجى *Monacha cartusiana*

منى عبد الحميد علي

معهد بحوث وقاية النباتات – مركز البحوث الزراعية الدقى- الجيزة- مصر

أجريت هذه الدراسة معمليا وحقليا بهدف مقارنة التأثير السام لمركب الثيمول وبعض مبيدات الافات وهى الكافروثرين، الراوند اب، النيوميل على الأطوار البالغة للقوقع الارضى *Monacha cartusiana* وكذلك فقس البيض. أجريت التجربة المعملية بطريقتين وهى طريقة غمر الاوراق وطريقة الطعوم السامة. وكانت النتائج المعملية كالتالى: مبيد النيوميل كان اقوى المركبات المختبرة تاثيراً على قوقع البرسيم يليه مركب الثيمول ثم مبيد الكافروثرين بينما كان الراوند اب اقل المركبات تاثيرا بطريقة الطعوم السامة حيث بلغت الجرعة النصف المميتة ٠,٧٩ و ١,٧٨ و ٣,٦٢ و ٠,٤٩ جزء من المليون لكل من الثيمول والكافروثرين والراوند اب والنيوميل على التوالى. كذلك كان مبيد النيوميل أكثرها تاثيرا فى فترة حضانة البيض لقوقع البرسيم حيث بلغ متوسط فترة الحضانة ٢٥ يوم يليه الثيمول٢٣,٥ يوم ثم الكافروثرين ٢٣ يوم اما الراوند اب كان اقلهم تاثيرا ٢٢ يوم مقارنة بمتوسط فترة التحضين للمجموعة الضابطة (٢٠ يوم). وهذا يوضح ان مدة الحضانة قد تاثرت بمعاملة البيض بالمركبات السابقة مما ادى الى اطالة فترة التحضين مقارنة بالكنترول. بالنسبة لتاثير المواد المختبرة على فقس البيض للقوقع فكان اكثرهم تاثيرا هو مبيد النيوميل ثم الثيمول ثم الكافروثرين واخيرا الراوند اب حيث بلغ متوسط عدد البيض الذى تم فقسه ١,٨ و ٣و ٤,٤ و ١ بيضة للثيمول و الكافروثرين و الراوند اب ثم نيوميل على التوالى. أظهرت النتائج الحقلية بطريقة الطعوم السامة نسب الخفض الاصابة بالقوقع الارضى *Monacha cartusiana* هى ٥٢,٣٢ و ٤٥,١٣ و ١٨,٩٤ و ٦٦,٨٦ % بعد المعاملة بثلاثة ايام وكان متوسط نسب الخفض ٥٥,٨٢ و ٥٠,٠٣ و ١٧,٢٠ و ٧٢,٦١ % للثيمول ويليه الكافروثرين و الراوند اب ثم النيوميل على التوالى. ومن هنا يتضح ان معاملة القواقع بالثيمول اعطت نتائج مؤثرة وقريبة من المعاملة بالمبيدات من حيث المعاملة للافراد البالغة وكذلك على البيض فلذلك يفضل استخدام الثيمول بطريقة الطعوم السامة لمكافحة القواقع حفاظا على البيئة من استخدام المبيدات التقليدية.