International Journal of Biochemistry, Biophysics & Molecular Biology
2016; 1(2): 42-45
http://www.sciencepublishinggroup.com/j/ijbbmb
doi: 10.11648/j.ijbbmb.20160102.12

Magnetic Water as Synergist of Pesticides Against *Monacha cartusiana*

Rania Ahmed Abd El-Wahab

Plant Protection Research Institute, Agricultural Research Center, Mansoura Branch, Dakahlia, Egypt

Email address:
rania-proline@hotmail.com

To cite this article:
Rania Ahmed Abd El-Wahab. Magnetic Water as Synergist of Pesticides Against *Monacha cartusiana. International Journal of Biochemistry, Biophysics & Molecular Biology.* Vol. 1, No. 2, 2016, pp. 42-45. doi: 10.11648/j.ijbbmb.20160102.12

Received: October 31, 2016; **Accepted**: November 24, 2016; **Published**: January 5, 2017

Abstract: Magnetic water was used as an attractive reagent of snails, *Monacha cartusiana*, to pick more pesticides namely Thiamethoxam and Diafenthiuron, under laboratory conditions for 24 hours. Toxicity, synergism and food consumption rate were assessed in the presence and absence of magnetic water. Without magnetic water Thiamethoxam showed higher activity with LC50 (5300 µl/l) than Diafenthiuron LC50 (6500 µl/l). With magnetic water, the toxicity clearly increased as the LC50s observed, were 1900 and 3300 µl/l of Thiamethoxam and Diafenthiuron, respectively, with synergism ratios 2.79 and 1.97% .Results revealed that mixtures of molluscicides and magnetic water could increase toxicity against *M. cartusiana* effectively.

Keywords: Diafenthiuron, Magnetic Water, *Monacha Cartusiana*, Thiamethoxam

1. Introduction

One of the major causes of biodiversity loss, economic damage (Lowe and others 2000), and potentially detrimental environmental changes is the prevalence of invasive alien land snails' species.

Thiamethoxam is a neonicotinoid insecticide is considered more effective than others since its action mainly affect the neural pathway in invertebrates (Kindemba, 2009). It has a similar mode of action to nicotine, linking the synapses of the nervous connections to the acetylcholine receptors (Abbink, 1991). Thiamethoxam exhibits exceptional systemic characteristics and provides excellent control of a broad range of commercially important pests, such as aphids, jassids, whitefly and thrips. (Ulaganathan and Gupta, 2004, Dewar, *et al.,* 2004).

Generally there are few studies evaluating the molluscicidal activity of various substances on terrestrial molluscs (Ferreira, *et al.*, 2009).

Modern toxicology shows that neonicotionoids have effects on the central nervous system of the freshwater snail *Lymnaea stagnalis*. That was including several metabolites belonging to different classes after exposure beside changes in the amino acids and nucleotide metabolites like tryptophan, proline, phenylalanine, uridine, and guanosine was found (Tufi et al. 2015). Many fatty acids were lost their regulation and the levels of the polyamines, spermidine and putrescine, were found to be increased which is an indication of neuron cell injury. A turnover increase between choline and acetylcholine led us to hypothesize an increase in cholinergic gene expression to overcome imidacloprid binding to the nicotinic acetylcholine receptors.

The other used pesticide Diafenthiuron, is defined as an inhibitor of mitochondrial ATP synthase of energy metabolism (compounds affecting the functioning of this protein) and moult inhibition. Hence, it is seen as a viable tool for managing insects and mites and acting on biochemical sites such as respiratory sites (Ruder and Kayser, 1992 and Ishaaya, *et al.*, 2001). Diafenthiuron is safe to parasitoids and predators (Zuhua and Shusheng, 1998 and Toress, *et al.*, 2002) and can be fitted into integrated pest management (Sun and Soo, 2000). Diafenthiuron' selectivity is associated to metabolism by microsomal oxidation (Kayser and Ellinger, 2001).

The present study is aimed at evaluating the acute toxicity of Thiamethoxam, (EZ)-3-(2-chloro-1, 3-thiazol-5-ylmethyl)-5-methyl-1, 3, 5-oxadiazinan-4-ylidene (nitro) amine, and Diafenthiuron, (1-tert-butyl-3-(2, 6-diisopropyl 4 phenoxy phenyl) thiourea), against *Monacha cartusiana* with and without magnetic water. In addition to this, the food consumption would also be determined in all cases in comparison with the control.

2. Material and Method

2.1. Magnetization of the Water

Nefertari magnetic water processor (Nefertari Company, Egypt) was used for magnetizing water by direct soaking for 3 days before treatments. Determination of magnetization was performed with the use magnetic meter and the results showed in Table (1). Tap water was magnetized by using a stainless tube containing four magnets on its inside.

Table 1. *Determination of magnetized water by Magnetometer.*

Water Types	Direct Determination(H)	Axis Graph Magnetic Meter		
		X	Y	Z
Magnetized Water	146.23	107.1	87.7	47.2
Control (Tap Water)	7.2	2.3	1.1	6.7

2.2. Monacha Cartusiana and Treatments

The adult snails *Monacha cartusiana* were collected from infested nurseries, local gardens and field crops in Mansoura region in Egypt. The obtained snails were transferred to the laboratory where they were kept in plastic containers filled with moist sterilized sandy loamy soil and fed on fresh leaves of lettuce and acclimatized for 2-3 days. The healthy adult snails with the shell diameter of mature individuals ranging between 11 and 13 mm were used in the bioassay such as toxicity tests. The magnetic water effect was tested against snails and the molluscicidal activity of compounds Thiamethoxam and Diafenthiuron was carried out against the adult snails for 24 hours. Stock solutions of toxicants were prepared and further diluted as per required. Ten adult snail individuals with approximately similar size were transferred from the stock culture to plastic cups. Pesticides were tested with and without magnetic water. Each cup was then covered with a muslin cloth held by rubber bands. Each of the above mentioned pesticides and the control were replicated ten times. The tested snails were examined, where the dead individuals were counted and removed.

2.3. Food Consumption Experience

Leaf discs of 5 g were used for each repetition. The leaf discs were dipped into the test solutions for 5 s with gentle agitation and allowed to surface-dry on a paper towel and placed into the rearing plastic boxes containing the experimental animals. The experiment was carried out in an environmental chamber at 25 ± 2°C, 75–85% RH and 12/12 h (L/D) for 24 hours. To determine the food consumption, the remaining food was removed from the rearing boxes and fresh food (5 g), treated with the pesticide solutions as mentioned above, was added to the boxes. Weight of the food remaining was measured to determine the food consumption of tested animals.

2.4. Statistical Analysis

Mortality percentages were recorded. Data analyzed by appropriate statistical methods and paired samples tests. The Relative Potency Factor calculated using the following equation: RPF=Toxic Potency (Index Chemical)/Toxic Potency (Chemical n).

3. Results

Data as shown in Table (2) observed that LC50 values were lower with magnetic water than without. LC50s of Diafenthiuron and Thiamethoxam were 3300 and 1900 (µl/l) respectively with magnetic water but they were recorded as 6500 and 5300 (µl/l) when used against the adult snails *Monacha cartusiana*. Synergism ratio recorded 1.97% and 2.79% of magnetic water for Diafenthiuron and Thiamethoxam respectively. Relative potency factor was assessed for each pesticide between the respective experimental set-ups, one with magnetized water and the other without. Results showed that RPF was recorded as 0.51 for Diafenthiuron treatments and for Thiamethoxam it was recorded as 0.36. Concerning the effect of magnetic water on food consumption for the adult snails *Monacha cartusiana,* which were exposed to the treated food with tested molluscicides, the results are shown in Table (3). Magnetic water increased the mean weight of food consumed after 24 hours of the bioassay in comparison with the controls especially the negative one. But through the controls, individuals even at negative or positive, all paired samples tests were highly significant even which occurred between treatments using magnetic water and those without (t=71.000**) or between treatments and the positive control (t=97.286**) and the negative control (t=98.215**). Also the same was found between the negative control and positive control (t=36.412**).

Table 2. *LC50s of tested molluscicides with and without magnetic water against adult snails Monacha cartusiana under laboratory conditions.*

Tested Pesticide	LC50s ((µl/l))				% Synergism Ratio	*RPF
	Without Magnetic Water		With Magnetic Water			
	Value (µl/l))	Limits 95% (µl/l)	Value (µl/l)	Limits 95% (µl/l)		
Diafenthiuron	6500	9880-4276.32	3300	3663-2972.97	1.97	0.51
Thiamethoxam	5300	6943-4045.82	1900	2052-1759.26	2.79	0.36

*Relative Potency Factor (RPF) =Toxic Potency (Index Chemical)/Toxic Potency (Chemical *n*)

Table 3. *Effect of magnetic water on food consumption of against adult snails Monacha cartusiana with tested molluscicides.*

Tested Pesticide	Mean weight of food consumed after 24 hours of bioassay (g)		
	Without Magnetic Water	With Magnetic Water	% Increase
Diafenthiuron	0.72	1.45	73
Thiamethoxam	0.89	1.38	94
Control	3.9	4.82	92

4. Discussion

Control of snails on different crops is heavily dependent on the use of pesticides that limit the effect of these pests to below their damaging level. Hence, the synthetic molluscicides or pesticides are the most effective available against terrestrial gastropods. Molluscs are of interest not only to farmers and the pesticide industry but also to ecotoxicologists as monitor species for environmental pollution. They encounter toxic materials either by contact or during feeding (Triebskorn and Ebert 1989).

Both pesticides used within the study proved their intoxication especially in the first hour after treatment with the same tested pesticides, Diafenthiuron and Thiamethoxam (Bhavsar and Patel 2011). Snails were still able to move actively following the first hours after treatment with pesticides after which the snails became immobile and inactive with increased secreted lucent mucus. With the use of magnetic water the snails were more active in the first 30 minutes following treatments and pick more quantities and consume more food in the first 30 minutes after which mortality increased gradually until all the snails died. Further, pesticides such as methomyl showed its molluscicidal activity as a dose-dependent against both snail species *E. vermiculata* and *Monacha contiana*, (Heiba, *et al.* 2002).

The molluscicidal effect increased positively with the magnetized water with an increased concentration of oxygen (O_2), while levels of carbon dioxide (CO_2), ozone (O_3) and chlorine (Cl_2) were reduced. By using this type of water against pesticides, it can contribute to increased toxicity of these pesticides and penetrate through the body cells of the exposed snails easier and smoother compared to using tap water to prepare required concentrations.

Anti-feedant activity was appeared on the contrary with neem preparation against terrestrial snails and proved by Mordue (2004). In most experiments, these preparations negatively affected the food intake of snails, but a phago stimulant effect was detected as well. The terrestrial snail, Zonitoides arboreus (Say, 1817), fed lettuce treated with neem extracts consumed significantly more lettuce than the controls. This effect occurred both for neem oil and a chemical pesticide having azadirachtin as its active ingredient (Hollingsworth and Armstrong 2003).

Magnetic water could be used as a safe adjuvant to molluscicides, which increase the effectiveness of the pesticides and uptake, which results in higher mortality and pose no hazard to the environment. In the same trend but in the present paper, magnetized water used as synergist of both tested pesticides, El-Zemity, *et al.* (2001) and El-Zemity and Radwan (2001) showed that carveol, thymol, eugenol exhibited high molluscicidal activity against *T. pisana* and *H. aspersa* snails that was further emphasized after using the synergistic combination with piperonyl butoxide which enhanced the molluscicidal activity of thymol and eugenol, against the *T. pisana* snail.

Even exposure of pesticides to magnetizers could cause high mortality against the two-spotted spider mite, *Tetranychus urticae* (Gòrski *et al.* 2009). The strong and significant increase in the effectiveness of zoocide Talstar (Bifenthrin), 100 EC after the application of one and three magnetizers, preparation Omite (Propargite) 30 WP after the application of two magnetizers, acaricide Magus (Fenazaquin) 200 SC after the application of one and two magnetizers as well as a simultaneous use of one magnetizer and two semi-rings. Acaricide Ortus (Fenpyroximate) 05 SC showed a marked increase in the effectiveness in all treatments with the use of magnetically modified water.

To conclude, magnetic water mixture with molluscicides could play an important role to increase toxicity against *Monacha cartusiana* and that is pointed out to more amounts picked firstly and then high mortality percentages than occurred with other treatments without magnetic water.

References

[1] Abbink J (1991). The biochemistry of imidacloprid. Pflanz. Nacher. Bayer. 44: p183-194.

[2] Bhavsar SS, Patel NG (2011) Molluscicidal activity of two pesticides against *Macrochlamys indica*. Golden Research Thoughts. 1 (VI): 1-4.

[3] Dewar AM, Haylock LA, Garner BH (2004). An appraisal of two insecticide seed treatments for sugar beet. British sugar beet review. 72 (2-28): p30-32.

[4] El-Zemity SR, Radwan MA (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): p483-493.

[5] El-Zemity SR, Mohamed SHA, Radwan MA, Sherby M (2001). Molluscicidal efficacy and repellency of some naturally occurring monoterpenoids against the land snail, *Helix aspersa*, Muller (Mollusca: Pulmonata). Annals Agric. Sci. Ain shams Univ., Cairo. 46 (1): p339-346.

[6] Ferreira PA, Soares LG, D'avila S, Bessa ECA (2009). The influence of caffeine and thymol on survival, growth and reproduction of *Subulina octona* (Bruguere, 1789) (Mollusca, Subulinidae). Brazilian Archives of Biology and Technology. 52 (4): p945-952.

[7] Gòrski R, Wachowiak M, Tomczak M (2009). The effect of water magnetized with negative magnetic field on effectiveness of selected zoocides in the control of two-spotted spider mite (*Tetranychus urticae* Koch). J Plant Protection Res. 49 (1): 87-91.

[8] Heiba F, Al-Sharkawy N and Al-Batal AA (2002). Effect of the insecticide, lannate, on the land snail, *Eopania vermiculata* and *Monacha contiana*, under laboratory conditions. Journal of Biological Sciences. 2 (1): p8-13.

[9] Hollingsworth RG, Armstrong JW (2003). Effectiveness of products containing metaldehyde, copper or extracts of yucca or neem for control of Zonitoides arboreus (Say), a snail pest of orchid roots in Hawaii. Int J Pest Manag 49: 115–122.

[10] Ishaaya I, Kontsedalov S, Mazirov D and Horowitz AR (2001). Biorational agents in IPM and IPM programs for controlling agricultural pests. Universiteit Gent. 66: p363-374.

[11] Kayser H, Eilinger P (2001). Metabolism of Diafenthiuron by microsomal oxidation: provide activation and inactivation as mechanisms contributing to selectivity. Pest Mgmt. Sci. 57: p975-980.

[12] Kindemba V (2009). The impact of neonicotinoid insecticides on bumblebees, honey bees and other non-target invertebrates. UK: Buglife-The Invertebrate Conservation Trust. p52.

[13] Lowe S, Browne M, Boudjelas S, De Poorter M. (2000). 100 of the world's worst invasive alien species – a selection from the Global Invasive Species Database. Switzerland: Invasive Species Specialist Group, Species Survival Commission, World Conservation Union. 12 p.

[14] Mordue AJ (2004) Present concepts of the mode of action of azadirachtin from neem. In: Koul O, Wahab S (eds) Neem: today and in the new millennium. Kluwer Academic Publishers, Dordrecht, pp 229–242.

[15] Ruder FJ, Kayser H. (1992). The carbodiimide product of Diafenthiuron reacts covalently with two mitochondrial proteins, the FO-proteolipid and porin and inhibits mitochondrial ATPase in vitro. Pestic. Biochem. Physiol. 42: p248-261.

[16] Sun YS and Soo KS (2000). Comparative toxicity of some pesticides to the predatory mite, *Phytoseiulus persimilis* (Acarina: Phytoseiidae) and the two spotted spider mite, *Tetranychus urticae* (Acarina: Tetranychidae). Korean J. Entomol. 30: p 235-241.

[17] Torres JB, Silva-Torres, CSA, Silva Murilo R, Ferreira JF (2002). Compatibility of insecticides and acaricides to the predatory stinkbug *Podisus nigrispinus* (Dallas) (Heteroptera: Pentatomidae) on cotton. Neotrop. Entomol. 31: p311-317.

[18] Triebskorn R, Ebert D (1989). The importance of mucus production in slugs' reaction to molluscicides and the impact of molluscicides on the mucus producing system. In: Henderson, I. F. (ed.) Slugs and Snails in World Agriculture. Monograph No. 41, British Crop Protection Council, Thornton Heath. p: 373-378.

[19] Tufi S, Stel JM, De Boer J, Lamree MHM, Leonards PEG. 2015. Metabolomics to explore Imidacloprid-Induced Toxicity in the Central Nervous System of the Freshwater Snail Lymnaea stagnalis. Environ. Sci. Technol. 49 (24): 14529-14536.

[20] Ulaganathan P, Gupta GP (2004). Effect of insecticidal spray on sucking pests of American cotton *Gossipium hirsutum*. Annals of Plant Protection Science. 12 (2): p283-287.

[21] Zuhua S, Shusheng L (1998). Toxicity of insecticides commonly used in vegetable fields to the diamondback moth, *Plutella xylostella* and its parasite, *Cotesia plutellae*. Chinese J. Biol. Cont. 14: p53-57.