EFFECT OF PERMETHRIN ON SURVIVAL AND REPRODUCTION OF *Bulinus globosus* MORELET 1868 AND *Bulinus truncatus* AUDOUIN 1827

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ABSTRACT

The effects of permethrin on reproduction and survival of Bulinus globosus and Bulinus truncatus are reported. Serial dilutions of the chemical were used in 96 h exposure tests on the molluscs, followed by postexposure maintenance in the laboratory for 8 weeks. There was significant decrease in oviposition with increase in pesticide concentration. There were significant differences between treatment-means for both egg mass and embryo counts for both species of molluscs. The F-LSD values at 5% alpha level for egg mass counts were 2.81 and 2.97 respectively for B. globosus and B. truncatus; 49.60 and 55.72 for the embryo counts in that order. The chemical did not produce an appreciable adverse effect on snail survival and longevity.

Keywords: Perrnethrin, Fecundity, Survival, *Bulinus globosus, Bulinus truncatus*

INTRODUCTION

Various reports indicate that sublethal doses of molluscicides and radiation do cause some impairment of survival and reproductive capacity in freshwater snails (Haroun *et al.,* 1996*;* Rondelaud and Dreyfuss, 1996; Abdel-Hafez, *et al.* 1997. Motta and Melo, 1997). Okafor (1990) reported that the xenobiotic, ivermectin at concentrations above 0.01 μg/ml is toxic to freshwater snails, resulting in mortality. But, below this concentration, this chemical does not evoke any major behavioural changes. Rather, it brings about significant reductions in egg output and no mortalities. Snail deaths as reported here can be attributed to an acute toxic effect and impaired oviposition to a chronic effect. This suggests that for the freshwater molluscs, a given toxicant may prove non-toxic or sublethal superficially and yet could indirectly affect their reproductive capacity adversely possibly by way of chronic toxicity. This, for the medically important, pulmonate snails may constitute an avenue for regulating those trematode infections transmitted by such molluscs (Okafor, 1990), given that even low level contamination of freshwater systems with such toxicants could reduce snail populations as much as to interrupt transmission.

Ecotoxicological studies with Permethrin (a non-cyanated pyrethroid) within the context of the West African Onchocerciasis Control Programme (OCP), demonstrated severe adverse effects by this insecticide on benthic invertebrate density following 15 weekly applications (Calamari *et al.,* 1998). That the changes in faunal density and diversity only became apparent after repeated application of the substance suggests that the mechanism of toxicity was more of the chronic than the acute type. This hypothesis is supported by the fact that the fauna recovered to almost pre-treatment levels 1 month from stoppage of insecticide spraying (Calamari *et al.,* 1998).

Having hypothesised that depressed fecundity is possibly a chronic response to sub-lethal doses of toxicants in freshwater snails, coupled with the fact that the ecotoxicological findings of Calamari *et al.* (1998) do suggest chronic toxicity for permethrin as well, it becomes exigent to investigate such responses on intermediate host snails, specifically. Therefore, the objective of this study was to determine whether or not permethrin has adverse effect(s) on postexposure survival, longevity and fecundity of the schistosome-transmitting bulinids – *Bulinus globosus* and *B. truncatus* –under laboratory conditions.

MATERIALS AND METHODS

Molluscs were exposed to 19 dilutions of permethrin (ranging from 0.01 – 150mg/l) prepared by measuring predetermined quantities of the dust formulation into IL plastic bottles. These were topped with deionised

water and shaken to uniform consistency. All molluscs survived the 96h exposures and were subsequently maintained singly for 8 weeks (mid-September to mid-November 2002) in 300ml of borehole water in 400ml plastic bowls. The controls were set up parallel in distilled water. Survival was assessed as the proportions of previously exposed molluscs that remained alive at weekly intervals postexposure (Okafor and Anya, 1991; Giovanelli *et al.,* 2002). The percentage of molluscs that survived to week 8 postexposure was taken as a measure of fecundity.

Four dilutions: 0.09, 0.9, 20 and 150mg/l were used to study the effect of concentration on egg-laying. After allowing for ovipositing to stabilise, 20 such individuals were exposed per insecticide dilution to serve as the experimental group. Twenty unexposed ovipositing individuals served as the control group. Both the control and experimental groups were monitored for oviposition for a fortnight. Two fecundity measures were adopted: (1) number of egg masses and (2) number of embryos (Okafor, 1991; Okafor and Anya, 1991 and Giovanelli *et al*., 2002). Egg mass and embryo counts were done every four days to coincide with water changes, with the aid of a hand lens. For the fecundity calculations, the 10 best ovipositing molluscs were chosen per insecticide dilution and same number for the control batch. The same control batch was used for comparison against all treatments.

Statistical Analysis: In order to ascertain whether or not there were significant differences in postexposure fecundity means, data was analysed by one-way analysis of variance(ANOVA),using the LSD to separate the means that were statistically different. Survival and longevity data were transformed into percentages.

RESULTS

Response of Adult Snails to Exposure: Of a total of 190 *B. globosus* adults treated to various concentrations of permethrin none was killed. None of the control individuals died during the period of exposure. Similar results were obtained for *B. truncatus.* .

Effects on Survival: No significant differences were obtained for post-exposure survival between the experimental and control snails for both species. The results for the 150 mg/l dose are summarised in Figures 1 and 2.

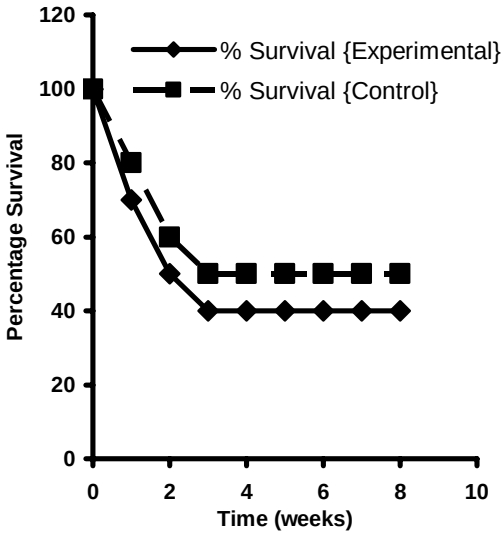

Figure 1: Percentage survival of *Bulinus globosus* 8 weeks after exposure to 150 mg/l of permethrin

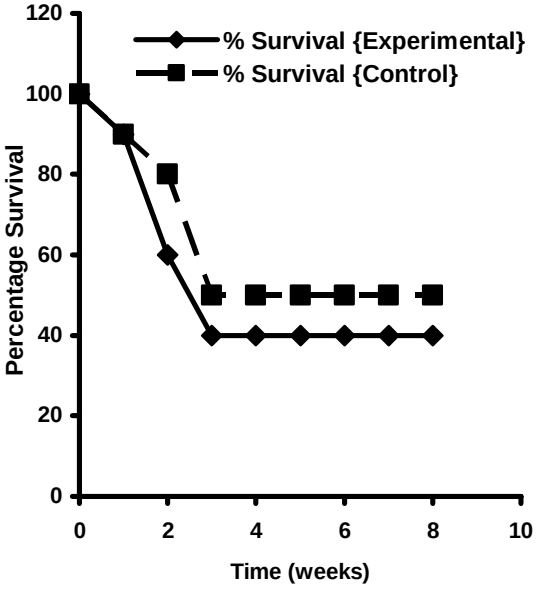

Figure 2: Percentage survival of *Bulinus truncatus 8* weeks after exposure to 150 mg/l of permethrin

Effect on Longevity: Forty percent of treated molluscs survived to week 8 and beyond versus 50 percent for the controls in both species, suggesting that there were no real differences in post exposure longevity between the different treatments (Figures 1 and 2)**.**

Effect on Fecundity: ANOVA results of differences between treatment-means differed significantly for both egg mass and embryo fecundity at 5% alpha level in the two species. The results are summarised in Table 1.

Table 1: Effect of different concentrations of permethrin on fecundity of two *Bulinus species*

Concentration (mg/l)	*B. globosus*	
	Egg mass	Embryo
0 (control)	11.30	165.00
0.09	9.40	96.70
0.90	11.40	136.30
20.00	5.90	54.90
150.0	4.60	45.70
LSD (0.05)	2.81	49.60
	B. truncatus	
	Egg mass	Embryo
0 (control)	12.10	175.70
0.09	13.10	147.70
0.90	10.00	100.00
20.00	6.80	67.80
150.0	4.70	73.80
LSD (0.05)	2.97	55.72

DISCUSSION

The results of the toxicity tests demonstrated that permethrin was not adulticidal on the 2 molluscs species It is thus concluded that the substance does not possess molluscicidal activity and cannot be considered a candidate for mollusc control. Therefore, use of this pesticide to control simuliid larvae as in the Onchocerciasis Control Programme of West Africa (Calamari *et al.,* 1998) does not seem to have posed any direct threat to freshwater gastropods. The absence of a significant difference in the rate of survival of the snails treated to different concentrations of the pesticide suggests that the pyrethroid did not influence the mortality pattern of the snails. Fecundity of the molluscs decreased significantly at permethrin concentrations from 20mg/l and above. This is evident from Table1.This suggests that though the substance might be superficially non-toxic to the snails, it could depress egg output significantly as to bring about variations in mollusc populations. Such changes in vector population densities could achieve a certain level of transmission control. Okafor (1990) reported that sublethal doses of ivermectin had similar effects on *B. globosus, Biomphalaria pfeifferi* and *Lymnaea natalensis. Impairment* of fecundity by sublethal doses of toxicants has been attributed to changes in the gonads of molluscs. Rondelaud and Dreyfuss (1996), demonstrated necrosis in gonad epithelia with sublethal doses of niclosamide; Haroun *et al.(*1996), demonstrated atrophy of the hermaphrodite gland with x-irradiation, which resulted in the suppression of gametogenesis; Motta and Melo (1997).

Conclusion: The findings of this study indicate that the dust formulation of permethrin (Rambo 0.6 a.i.), did not influence overall survival and longevity adversely. However, it depressed egg output significantly.

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