TOXICITY OF AN ORGANOPHOSPHORUS INSECTICIDE TO ORGANISMS IN LABORATORY TESTS AND IN A MESOCOSM STUDY

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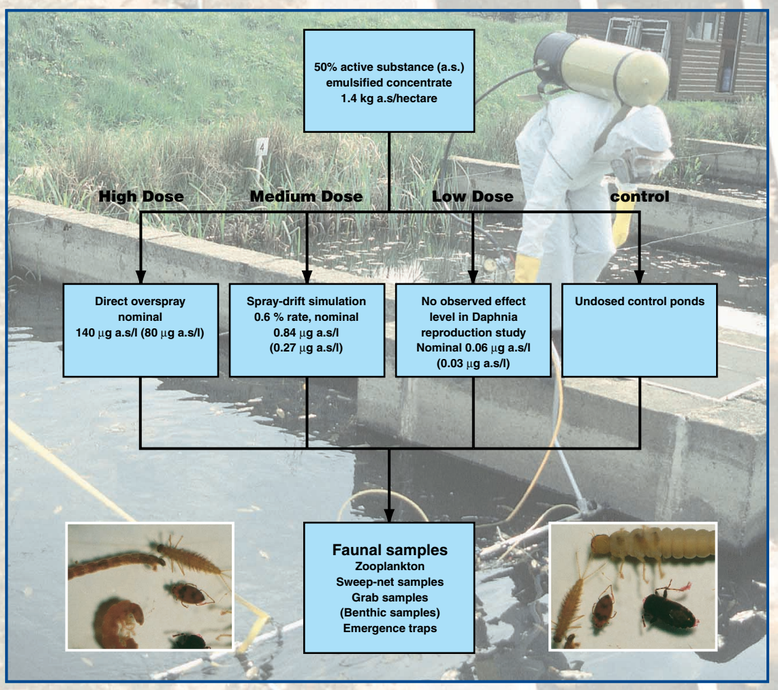
Introduction

A mesocosm system was used to assess the potential impact of the organophosphorus insecticide pirimiphos-methyl upon aquatic ecosystems. Available physico-chemical data indicates that it is short-lived in the water-column (1day half-life) and will become associated with the sediments (half-life 10- 30 days). This suggests benthic species may be most affected.

Methods

24 ponds of 50m³, 1 metre depth and including sediment. 3 replicate ponds per treatment



Results

Although the abundance of individual species of zooplankton and benthic organisms (chironomids) was shown to decrease with treatment level, community data is multivariate in nature. Handling community data using multivariate analysis maximises the potential for identifying under-lying effects upon community structure that may not be apparent from analyses using univariate techniques alone.

Species abundance data in each treatment group were also analysed by multidimensional scaling (MDS) using square root transformation and the Bray-Curtis similarity index. The ANOSIM randomisation test was used at significance level of P>0.05 to confirm differences between sites with similar species assemblages identified in MDS ordinations.

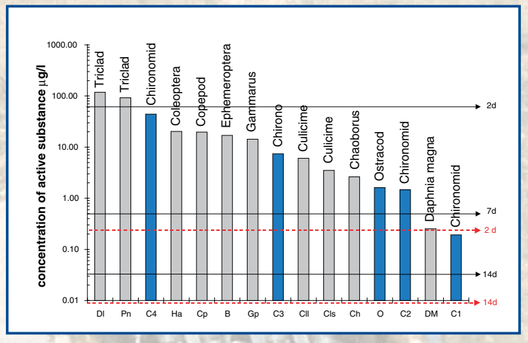


Figure 1. Concentration of pirimiphos-methyl between 2 and 14 days after dosing in high (black) and medium (red) dose ponds compared to 48 hour LC50 data for a range of species tested in the laboratory.

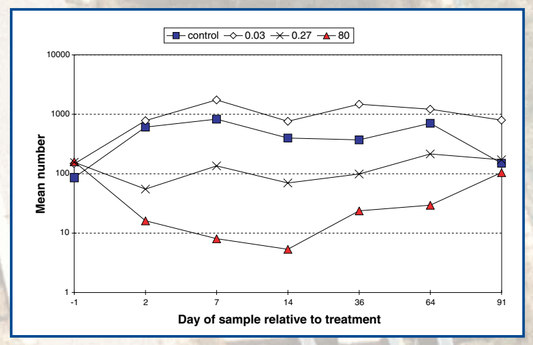


Figure 2, the mean number of ostracods per zooplankton sample was significantly lower in high and medium dose ponds, between day 2 to 64 post dose relative to low dose and control ponds.

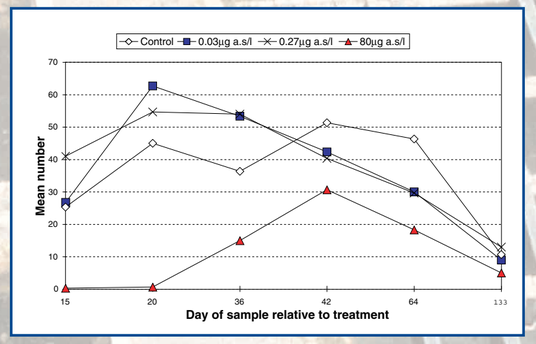


Figure 3, the mean number of chironomids on emergence traps was not significantly different in the medium dose (0.27 µg/l) day 14 post dose. High dose not different day 42 post dose.

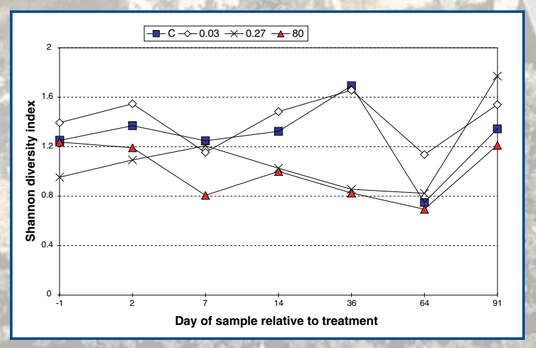


Figure 4, mean Shannon species diversity index for each treatment type, high dose significantly different day 7 to day 64 post dose, medium dose group different day 14 to 64. All similar day 91.

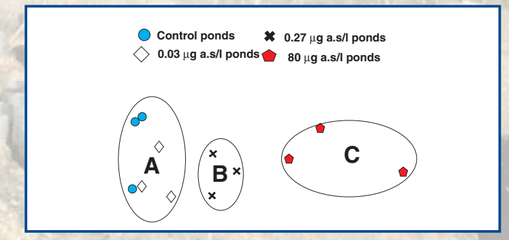


Figure 5. An MDS plot of species abundance data shows that at day 14 post dosing the control and lowest treatment group (0.03µg/l) ponds are similar (group A) and the medium (0.27 µg/l, B) and high (80 µg/l, C) dose ponds are siginificantly different (p<0.05).

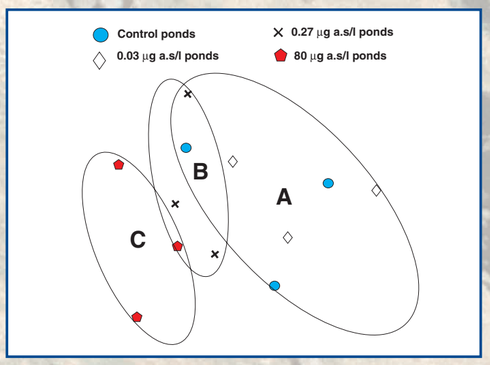


Figure 6, by day 64 post dosing the medium dose ponds (B) are not significantly separated from the control and low dose group (A) or the high dose ponds (C). The high dose ponds are however significantly different from those in group A.

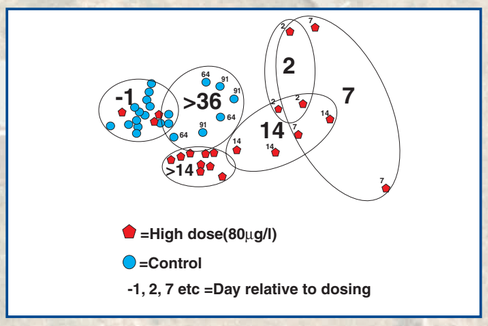


Figure 7. Over a 91 day period post dosing the community structure of the high dose ponds is significantly different from the control ponds until the end of the study. From day 36 however control ponds are also different from their starting condition.

Conclusions

- The physicochemical data indicate that pirimiphos-methyl would not persist in the water column, this was confirmed by the analytical data.
- It did not persist in the sediments and was below the detection limit (0.5 µg/kg dry weight) on day 14 post dosing. Benthic species however were affected (e.g. chironomids) and did not recover in number until day 42.
- This probably relates to the greater sensitivity of early instars and the time taken from egg to adult.
- Univariate statistics such as the Shannon species diversity index do not show differences between groups at day 91
- However multivariate analysis indicates that at day 91 the community structure of the highest treatment group is still significantly different from the control and the community in control samples has also changed from day 36 onwards as a result of seasonal factors.

Acknowledgement

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