FUMIGATION OF GIANT AFRICAN SNAILS (*ACHATINA FULICA*) USING METHYL BROMIDE AND METHYL IODIDE

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The Ministry for Primary Industries in New Zealand (NZ MPI) wanted to evaluate Methyl iodide (MeI) as a possible replacement for Methyl bromide (MBr) as it is desirable to obtain alternative fumigants for quarantine and pre-shipment use against pest species, and especially against those pests considered to as being "difficult to kill". The Giant African Snail or GAS (*Achatina fulica*) is one such "difficult to kill" species that causes quarantine problems worldwide and is frequently intercepted in NZ. As this pest is not found in NZ, NZ MPI looked for opportunities to run a suitable mortality trial in a country where it occurs. As GAS is common in Samoa, NZ MPI obtained permission from the Samoan Ministry of Agriculture and Fisheries (Samoa MAF) to cooperatively run the trial there.

NZ MPI and Samoa MAF evaluated fumigation of aestivating GAS that were held in secure, fumigant permeable "cages" inside replicate refrigerated shipping containers. The containers were set at 3 temperatures to simulate mean New Zealand temperatures in winter (12^{o}C) and summer (17^{o}C), and ambient Samoan/Pacific Island conditions (30^{o}C). Various concentrations of MeI and MBr were independently injected into each container where acute snail mortality within each replicate cage was determined immediately after a 24 hour fumigation period. Trial data was analysed as a two-factor logistic regression and probability of mortality was fit to a logistic cumulative distribution function applied to a linear model that used temperature, fumigant concentration, and the interaction between temperature and fumigant concentration as explanatory variables.

Based on the results obtained, it was determined that mortality results for GAS are strongly influenced by temperature. The impact of temperature also showed significant interactions with each fumigant concentration, which resulted in varying mortality responses for GAS. For MeI and using shipping containers as fumigation chambers, results indicate that complete kill (100% GAS mortality) after 24 hours of fumigation would be attained using 260 g/m^3 at 12^{o}C; 81 g/m^3 would be needed at 17^{o}C and 37 g/m^3 would be needed at 30^{o}C. Where MBr was used, results indicate that complete kill (100% GAS mortality) after 24 hours of fumigation would be attained using 465 g/m^3 at 12^{o}C; 132 g/m^3 at 17^{o}C; and as low as 27 g/m^3 at 30^{o}C. It was only at 30^{o}C that the fatal concentration of MBr needed for complete GAS kill after 24 hours is indicated at being lower than the currently rate (128 g/m^3) used for GAS treatment in NZ.

It is important to note that the focus of the trial was to assess acute mortality only, and immediately after the 24 hour fumigation period had elapsed. However, it is the considered position of the authors that GAS mortality rates would have been significantly greater if the chronic impacts of the fumigants had been assessed over a longer time period (in addition to the immediate acute effect after the 24 hour period of fumigation had ended). The results obtained are therefore likely to be a very conservative estimate of the fumigant concentration needed for complete mortality of GAS if the longer term effects of the fumigants had been taken into consideration. In the future, trials could be conducted to investigate the chronic effects of fumigants but this consideration was outside the scope of the trial conducted.

In practical terms, the trial provided very positive results for tropical countries where fumigation of GAS would occur at temperatures approximating $30^{o}C$ as a much lower rate of MeI or MBr could be applied. The results were more variable for lower temperatures, and considerably higher application concentrations of MeI and MBr were required to achieve 100% acute mortality immediately after 24 hours.

In a similar way to MBr, MeI is a broad spectrum fumigant with similar utility and effectiveness. Fumigation operators who are familiar with MBr fumigation should therefore be able to easily manage MeI fumigation in the field or industrial settings. The only challenge observed during this trial was that MeI does require a higher initial temperature for vaporization. As MeI has been found to pose no threat to ozone depletion, it should be further considered as a suitable replacement for MBr for quarantine and pre-shipment use under similar occupational safety and health management regimes.