A survey of phosphine and methyl bromide resistance in Malaysia

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Abstract

Insects were collected from grain storages, flour mills and feed mills at 30 locations in Peninsular Malaysia during 1991–92. Laboratory bioassays using the FAO resistance testing method indicated that resistance to both methyl bromide and phosphine was widespread. Use of methyl bromide is not widespread in Malaysia but a large proportion of grain is fumigated prior to import. Phosphine is in common use in Malaysia.

Introduction

The earliest study on insect resistance to fumigants was reported by Champ and Dyte (1976). Their survey showed an increased tolerance of insects to fumigants, which subsequently led to worldwide reports of control failures resulting from resistance (Attia and Greening 1981; Borah and Chahal 1979; Taylor and Halliday 1986; Tyler et al. 1983; Zettler et al. 1989). In Malaysia, the first survey on resistance was carried out in 1985 (Rahim and Ong 1991). The results then indicated that some insects had shown resistance to malathion and methyl bromide. There was no indication that the test insects, *Sitophilus* spp., *Tribolium castaneum, Oryzaephilus surinamensis* and *Rhyzopertha dominica,* were resistant to phosphine although it is more widely used than methyl bromide to control insect infestation in stored paddy and milled rice. Methyl bromide is more often used on grain commodities before import into Malaysia, i.e. to meet the quarantine requirement.

During 1991-92 period, another survey was carried out. Samples of grains containing insects were collected from various Malaysian National Rice Board complexes/warehouses and private feed mills and paddy mills scattered all over Peninsular Malaysia. The objective of this study was to check on the extent of insect resistance to methyl bromide and phosphine in Malaysia food storages.

Methods and Materials

Four major stored-grain beetle pests were tested: *Sitophilus oryzae, S. zeamais, Tribolium castaneum* and *Rhyzopertha dominica.* Insects collected from various premises were cultured separately in fresh and sterilised media. The screening was carried out when the insects had established in the media and sufficient numbers of insects were available. Phosphine (generated from a commercial aluminium phosphide formulation) and methyl bromide were collected and injected using gastight syringes through rubber septum's in the lids of desiccators containing the test insects confined within glass rings, to give the required concentrations. The insects were exposed to various concentrations of methyl bromide (MeBr) and phosphine (PH_3) recommended by FAO for 5 and 20 hours (see Table 1), respectively (FAO 1975). After the exposure periods, the insects were transferred to sterilised culture media and held at 25°C and between 70-80% r.h. Assessments were carried out 14 days after treatment. For each test, between 40–50 insects and 3–4 replicates were used.

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Results and Discussion

Table 2 shows the results obtained from the test carried out in the laboratory using both fumigants. The results obtained from the 1985 survey had indicated that the insect strains collected were not resistant to phosphine but to methyl bromide. In this study, however, the insects collected showed some levels of resistance towards both phosphine and methyl bromide, particularly *Tribolium castaneum* and *Sitophilus spp.* Thus, in order to overcome these insect resistance problems, there is a crucial need for researchers to identify new alternative fumigant(s) which are effective and at the same time they are safe and environmentally friendly.

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Table 1. Insect species, fumigant, concentrations and exposure periods used in the test for resistance.

Insect species	Phosphine		Methyl bromide	
	Conc. (ppm)	Exposure period (hours)	Conc. (ppm)	Exposure period (hours)
Sitophilus oryzae	0.04	20	6	5
Sitophilus zeamais	0.04	20	6	5
Tribolium castaneum	0.04	20	12	5
Rhyzopertha dominica	0.03	20	7	5

Table 2. Insect strains which slow resistance towards methyl bromide and phosphine (PH_3).

Premises	*Tribolium castaneum*		*Sitophilus* spp.		*Rhyzopertha dominica*	
	Methyl bromide	PH_3	Methyl bromide	PH_3	Methyl bromide	PH_3
Complexes	4/7	3/10	4/9	1/9	0/4	4/4
Warehouses	2/4	1/5	1/3	0/4	0/1	–
Feedmills/flour mills	4/4	1/7	6/13	1/14	0/8	7/7

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