DEMONSTRATION PROJECTS IN SOUTHEAST ASIA

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Background

The funding of demonstration projects on the replacement of ozone-depleting substances in developing countries through the Multilateral Fund is facilitated through several Implementing Agencies, one of these being the United Nations Industrial Development Organization (UNIDO). This organization has the responsibility for projects to demonstrate alternatives to the fumigant methyl bromide used to disinfest durable commodities in Indonesia and Vietnam. Annual use of methyl bromide in these countries is of the order of 200 and 300 tonnes respectively. After a preliminary assessment of alternative technologies that might be appropriate to demonstrate in these countries, and identification of local counterpart agencies, projects were formally prepared and presented to the respective governments for ratification in late 1999 or early 2000.

Current uses of methyl bromide

The largest use of the fumigant in Indonesia is for pre-shipment and quarantine treatment of commodities in freight containers intended for export, a usage currently falling outside controls on methyl bromide. However, some container fumigations are conducted on the basis of contractual rather than official requirements, thus permitting the inclusion of alternative technology demonstrations in project activities. Among the major commodities treated in containers are coffee, tapioca, and wooden furniture products. Another important but much smaller use for methyl bromide in Indonesia is the fumigation of stored rice held in bag stacks.

As in Indonesia, the major use for methyl bromide in Vietnam is the treatment of products prior to export, but in that country the major commodity exported is rice. The rice is fumigated either immediately before loading or on board ship. Some fumigation of rice with methyl bromide, and also components of animal feed such as maize, takes place during storage either in bag-stacks or in silos. The fumigation of commodities in containers with methyl bromide in Vietnam prior to export is common practice, coffee being one of the commodities that is frequently treated. Approximately 20% of methyl bromide consumption in Vietnam is for non-quarantine and pre-shipment fumigations.

Alternative technologies demonstrated

Cylinder phosphine

Phosphine generated from solid metal phosphides has been used as a commodity fumigant for many years in both Indonesia and Vietnam, but is often inappropriate or unpopular because of the long exposure period required. Commercial pest control

servicing companies in these countries, therefore, almost always use methyl bromide unless otherwise instructed by the customer. The recent wider availability and use of phosphine in cylinders mixed with carbon dioxide, e.g. $ECO_2FUME^{™}$, has resulted in the mixture now being more favourably considered as an alternative to methyl bromide. Use of cylinder phosphine may permit a shortened exposure period compared to solid metal phosphides, and the absence of any particulate residues makes the cylinder gas more suitable in some applications. The potential of cylinder phosphine to treat containers is not unlike the application of methyl bromide, and could be of particular significance where containers are already custom-sealed prior to presentation for fumigation.

Integrated Pest Management

The use of IPM programmes has been practised for many years by the parastatal organization BULOG in Indonesia, and the project provided an opportunity to upgrade and intensify these practices. The majority of commodity storage in Vietnam is in the private sector but store operators are willing to co-operate in upgrading sanitation practices. These include general store hygiene and inspection, and use of the 'first in first out' principle for commodities stored. The introduction of insect barriers, already tried in several countries, including Indonesia in the 1970s, (McFarlane, 1980) was deemed worthy of demonstration in both countries. The barriers used in the Indonesian project are cotton covering sheets for bag-stacks: these sheets are intended to prevent cross infestation or reinfestation by insects, a principal cause for repeated stack fumigation. Bait bag traps are used to assess insect population increases in bag stacks, uncovered stacks being used as experimental controls.

Project programmes and progress made

The broad programme of demonstrations of alternatives to methyl bromide fumigation is similar in both Indonesia and Vietnam although greater progress has been achieved to date with the project in Indonesia. In the latter, demonstrations using cylinder phosphine have been in progress since early 2000 both for shipping containers and for rice in bag stacks. Concurrently, demonstration involving the use of stack covers for bag stacks of rice have been in progress. In fumigations with phosphine, the results (Tables 1-2) of gas concentration measurements indicate that effective insect control can be expected in all treatments except for the fumigation of wood (pallets) in containers. Here, after five days, the concentration of phosphine was less than the 150 ppm that is regarded as indicative of effective fumigation practice. Results of bioassays, and from bait traps counts (Tables 3-5) from the demonstrations in Indonesia show the effectiveness of the fumigations, and also of the cotton sheets in preventing stack re-infestation. An economic analysis of alternative technologies is currently being refined, and the one-day awareness workshop (April) and four-day training course (August) are important project activities.

References

McFarlane, J. A.(1980) Technical and economic possibilities for simple improvements in maintenance of quality in milled rice during storage. *Proceedings of the 3rd Annual Workshop on Grains Post-harvest Technology,* Kuala Lumpur, Malaysia. 29-31 January 1980. 392-398 pp.

GAS CONCENTRATIONS RECORDED DURING FUMIGATIONS CONDUCTED IN INDONESIA

Table 1. 200–tonne rice stacks[1]

Fumigant used	AlP tablets	Cylinder phosphine	Methyl bromide
Dosage	2 g/tonne	21 g/m^3	21 g/tonne
Gas conc. after one hour [2]	254 ppm	716 ppm	15 mg/l (3800ppm)
Conc. day 2	1700 ppm	600 ppm	11 mg/l (2800ppm)
Conc. day 5	2000 ppm	400 ppm	

[1] Results from treatments at two locations

Table 2. Freight containers (33 m^3 capacity)

Fumigant used	ECO_2FUME^{TM} Coffee	ECO_2FUME^{TM} Wood products	Methyl bromide Coffee & Wood products
Dosage	21 g/m^3	21 g/m^3	32 g/m^3
	640 ppm	550 ppm	>20 mg/l (5000 ppm)
Conc. day 4	460 ppm	250 ppm	
Conc. day 5	400 ppm	145 ppm	

[2] Average concentration from gas samples taken at top, middle and bottom locations in two container treatments

Insects used for bioassay in all treatments include *Tribolium castaneum* and *Sitophilus oryzae*.

RESULTS OBTAINED FROM BIOASSAYS OF FUMIGATIONS, AND FROM BAIT BAG TRAPS IN RICE STACKS IN INDONESIA

Table 3. Results from containers fumigated with $ECO_2FUME^{™}$ and with methyl bromide showing total counts of inserted samples of *S. zeamais* *

	Methyl bromide		$ECO_2FUME^{™}$			Controls	
Commodity	Live	dead	Live	dead		Live	dead
					Wk.1	96	0
Coffee	0	150	0	150	Wk.2	151	0
					Wk.3	410	0
Wood	0	150	0	150	Wk 4	799	0

* 2 replicate containers, 6 replicate samples of insects per container

Table 4. Results showing total insect counts of inserted *S.zeamais* and *T.castaneum* in rice bag stacks fumigated at Tambun and Buduran in Indonesia

		Methyl bromide		$ECO_2FUME^{™}$		Controls	
		Live	dead	Live	dead	Live	dead
S. zeamais	Wk.1	0	150	0	150	150	0
	Wk.4					1712	0
T. castaneum	Wk.1	0	150	0	150	150	0
	Wk.4					150+ 73 larvae	0

Table 5. Counts of total insects numbers from bait traps (12/stack) placed in replicated rice stacks fumigated at two locations in Indonesia**.**

1. Tambun research station West Java

Treatment	Methyl bromide	$ECO_2FUME^{™}$	$ECO_2FUME^{™}$ + cotton sheet	ALP tablets
Month 1	0	0	0	0
Month 2	1	0	0	1
Month 3	11	0	0	0
Month 4	150	174	0	151
Month 5	277	224	0	204
Month 6	344	214	0	220
Month 7	341	113	0	161

2. Buduran operational warehouse East Java

Treatment	Methyl bromide	$ECO_2FUME^{™}$	$ECO_2FUME^{™}$ + cotton sheet	ALP tablets
Month 1	0	0	0	0
Month 2	56	0	0	55
Month 3	473	362	0	498
Month 4	1184**	877**	110	1055**
Month 5	2	7	3	7

**Insect numbers exceeded threshold (40/trap) and stack required re-fumigation