Regional Workshop for Asia and the Pacific: Constraints and Solutions on the use of Phosphine as an alternative to methyl bromide for durable commodities

29 September - 2 October 2003
Ho Chi Minh City, Viet Nam
I. EXECUTIVE SUMMARY

The Regional Workshop for Asia and the Pacific: Constraints and Solutions on the Use of Phosphine as an alternative to methyl bromide for durable commodities was held in HCM City, Vietnam on 29 September-2 October 2003.

Two representatives from nine countries in the Asia and the Pacific region were invited and participated in this workshop. Two countries sent additional participants to this workshop at their own cost. The MBTOC co-chair and another expert on good fumigation were also in attendance, along with active participation from UNIDO.

The workshops were structured around different sessions, with a practical session out in the field showing hands-on experience on how fumigation is done. The sessions were:

Session I  MB Phase out in Asia and the Pacific: Status of compliance
Session II Alternatives to MB in the commodities and durables sector
Session III Good Fumigation Practices
Session IV Using the Grain Tutor Kit
Session V Working Group Discussions
Session VI Practical and hands-on session on the proper use of phosphine in containers

The above topics discussed the relevant issues facing the use of phosphine as an alternative to MB for treatment of durable commodities. The questions raised during the end of each session showed that although many countries are currently using phosphine in such treatments, the problems associated with it such as insect resistance and corrosion of machinery treated pose a number of constraints to its wider use.

The participants appreciated the expert advice provided by the invited resource speakers. They also valued the insights given especially on the aspects of good fumigation practices which are not commonly really done in the participating countries.

Country presentations focused on the extent of phosphine use in each country, and the prospects for broader phosphine application if and when the identified constraints can be solved. It appears that there are indeed possibilities for more extensive use of this alternative. In fact in some countries, methyl bromide is the alternative for phosphine in case of infestation that needs to be treated urgently, as the country prefers this to MB in a number of applications. It was raised however that if the problems associated with its use are not given enough attention through training, development of standards, then there could be a consequent increase in MB use for certain applications where phosphine is now the fumigant of choice.

A session was also devoted to the use of the Grain Tutor kit, a computer based software prepared by CSIRO. This provided the participants with an important resource that can be used for training on good fumigation practice.
A trip to one of the demonstration sites of the host country was also made; this was coupled with a specific and practical session showing how a container is readied for fumigation, taking into consideration all the practices discussed during the workshop. Participants were also given the opportunity to try on the various monitoring equipment used during fumigation, and be familiar with how they looked like. This session was especially useful for the NOUs who are not accustomed to these equipment.

The Conclusions and Recommendations (Annex 1) agreed upon during the workshop reiterated that phosphine is the most important alternative of choice for durable commodities. However, insect resistance and other constraints must be solved in order for the use of this to be more widespread and reliable in each country. Training on good fumigation practice was found to be an area that needed focus, likewise the importance of coordination between government regulatory agencies and fumigators to have consistent policies on what can be used during the fumigation process.

The meeting also recommended consideration that phosphine is already widely used, and that projects to be funded from the MLF should look at how these limitations on its use can be improved, rather than further studies on this substance as an alternative. The other area that the meeting considers important is the fact that reversion to MB use is possible unless these problems are solved.

II. BACKGROUND

The UNEP Methyl Bromide Technical Options Committee (MBTOC) has identified phosphine as one of the most effective and widely used alternative to methyl bromide (MB) for the treatment of durable commodities. Worldwide much larger tonnages of durables, such as grains, are treated with phosphine than with methyl bromide. It is widely registered in most countries, and aside from the potential to be a direct replacement for MB in many situations, it can also be an important component of an IPM system for treating pests whereby avoiding MB use.

Phosphine is a highly toxic fumigant, but is used in very low concentrations. There are a number of formulations and procedures that can be used to ensure its safe use. Although its action against pests is as effective as MB (i.e. complete kill is usually obtainable), it acts more slowly and needs long exposure periods for full effectiveness.

In the report of the Regional Workshop on the Use of MB Alternatives Evaluated Under the Multilateral Fund’s Demonstration Projects in Asia and the Pacific, held in September 2002, participants recognized the importance of phosphine as an alternative to durable commodities, which is one of the biggest uses on MB in the region. However, there was also an agreement that before full use of phosphine is possible in their countries, it is important that the constraints that could potentially limit the use of phosphine, and solutions for these must be discussed and identified so that such transition will reduce economic and technical impacts.

In particular, inappropriate use of phosphine has already been shown to give rise to pest resistance and reduced effectiveness in the Region and elsewhere. Good fumigation practice is needed with phosphine to ensure the continued availability of
this valuable fumigant. Loss of this fumigant would not only reduce alternatives to methyl bromide but would also increase pressures to renew use of methyl bromide in situations where phosphine is currently the only other option.

This regional workshop attempts to identify the problems that could be associated with phosphine use, and will come up with specific recommendations on how these can be reduced in order for phosphine fumigation to work as well as MB.

**III. WORKSHOP OBJECTIVES**

The main objectives of this workshop are the following:

- To widely disseminate the advantages of using phosphine as an alternative for durable commodities
- To present the problems and constraints associated with phosphine use and identify ways to overcome them.
- To alert participants to the dangers of development of pest resistance to phosphine and present ways of preventing or managing this development
- To encourage the increased use of phosphine as an alternative and reduce the use of methyl bromide
- To raise awareness about and to encourage and promote adoption of effective alternatives to MB especially for durable commodities

**IV. EXPECTED OUTPUTS**

This was a four-day workshop that consisted of presentations and group discussions, and culminated with a field trip to a site where phosphine is being applied. The following main topics were discussed:

- Characteristics of phosphine as compared with MB
- Using phosphine effectively and guidelines for its use
- Various formulations of phosphine and their best applications
- Causes and management of pest resistance in phosphine
- Use of phosphine for treatment of durable commodities.
- Site visit to see how phosphine is applied with specific emphasis on what needs to be ensured during fumigation to make it most effective
- Sealing techniques
- Long and short treatment periods: which commodities are these best suited for?

The group discussions will aim to identify the common problems associated with phosphine use, and present solutions for these. Specific actions on a country per country basis for disseminating the information received during this workshop will be developed, with target outputs and indicators.

**V. PARTICIPANTS**

- Representatives of National Ozone Units from Asia and the Pacific countries.
  Priority countries are those whose consumption of MB is mainly in the durables and commodities sector.
Representatives from Agriculture Ministries or Pesticide Control Authorities from Asia and the Pacific countries that regulate methyl bromide use.

Representatives from fumigation companies in the region

Technical experts in grain storage and QPS issues

Representatives from Ozone Secretariat, Multilateral Fund Secretariat and implementing agencies.

VI. METHODOLOGY

Invited experts, and also country representatives divided the workshop up into six main sessions where presentations were made. A discussion/open forum where participants could ask questions and could seek clarification for certain issues that were unclear followed each session.

There were two hands-on sessions included during the workshop, one on using a software to improve fumigation practices, and one field session where participants were shown how real fumigation is done, using both stack and container fumigation as examples.

VII. CONTENTS

7.1 Opening Session

Mr. Du, representative of the Ministry of Natural Resources and Environment (MONRE) in Ho Chi Minh City made the statement in behalf of the government of Vietnam. In his statement, he recalled the earlier efforts that Vietnam has made towards meeting compliance with the Montreal Protocol and emphasized the work that was put into ensuring that Vietnam is on track.

He expressed appreciation that this workshop is being held in their country, and mentioned that methyl bromide phase out is one of the challenges of the Montreal Protocol. He also pointed out how this workshop is timely, especially for this region where a large amount of phosphine is used in durable commodities.

Cecilia Mercado from the UNEP CAP in the Regional Office in Bangkok in her Opening Statement emphasized that holding this activity is essential particularly for phosphine users, so that they do not revert back to MB use when problems with phosphine use occur. She also mentioned that many countries in the region already use phosphine, but that the issue of insect resistance has hindered a broader application of this chemical. She hoped that this workshop could contribute to finding workable solutions to the problems related to phosphine use, and looks forward to its broader use in the future, as a replacement to MB.

She also gave a short brief on the role of the new CAP programme based in the UNEP regional office in Bangkok, and stressed on the availability of specific country assistance to be provided by the CAP staff. She encouraged countries in the region to make use of these services especially during this compliance period in order for technical assistance to be readily accessible to them.
7.2 Session I: Chair: Indonesia
Methyl Bromide Phase out in Asia and the Pacific: status of compliance

7.2.1 Presentation 1 -- Compliance situation of Asia and the Pacific Countries to MB Control measures under the Montreal Protocol and Methyl Bromide consumption trends and future use in the region.

7.2.1.1 Cecilia T. Mercado presented the methyl bromide consumption profile for countries in both the South Asia and SEAP region. During this presentation, countries that were on potential non-compliance were mentioned, and were encouraged to immediately launch actions that would bring them back into compliance. She related specific issues for some countries, such as Malaysia and the Philippines who are presently finding difficulties in reporting accurate data due to certain inconsistencies in definitions of MB use. This part of the presentation therefore locked in on the potential problems being faced by countries related to data collection and data reporting, with the presentation urging countries to ensure that their data can be easily verified if needed. Some suggestions on how data reporting can be improved such as surveys and specific questions that can be asked during these surveys were also mentioned.

7.2.1.2 The presentation also briefly mentioned the number of projects that have been approved for the region, focusing in particular on those demonstration projects that used phosphine as an alternative to MB. Results of these projects have shown quite positive trends, and countries are therefore urged to see how this alternative can be made more readily accessible and used in the durables sector.

7.2.1.3 During the discussion after the presentation, countries inquired as to the policies of the Executive Committee on changing data baselines. It was explained that as far as the policies and guidelines are concerned, the countries are allowed to change their baseline data at least once, so this has to be carefully submitted.

7.2.1.4 Other concerns raised were associated with the definitions of Quarantine and Pre-shipment (QPS), which are currently exempt from controls under the Montreal Protocol. This perennial problem has been brought up in a number of MB workshops, and network meetings, and countries continue to have difficulties in applying the Montreal Protocol definitions. Ms. Mercado gave a brief presentation on QPS definitions, and with the assistance of Dr. Jonathan Banks, MBTOC co-chair, described situations/cases where MB use is really QPS following the definition, and where in certain applications that are ambiguous, to use specific criteria to see how this can be classified as QPS.

7.2.2 Presentation II-- Demonstration projects using phosphine in the region and an overview of their results.

7.2.2.1 Alessandro Amadio from UNIDO made a presentation looking at the various demonstration projects that UNIDO has implemented, with a special focus on what has completed in the region. He showed that their storage demonstration
projects are being implemented, and that most of the demonstration projects of UNIDO are on soil application. The countries in the region that have had demonstration projects are Vietnam, Indonesia and Thailand in the area of commodity storage demonstration projects.

7.2.2 Specifically for the Asia and the Pacific region, Thailand has had a demonstration project using phosphine and ICM, Indonesia used phosphine and phosphine plus CO2, Vietnam’s project is also using phosphine as a fumigant for commodities. All projects showed very good results in terms of phosphine use.

7.2.3 His conclusions are that alternatives exist and are widely used in both developed and developing countries. MB is used only for large agriculture farms, and not used in subsistence agriculture. Training and Technology are essential components of phase out plans, and he said that the Montreal Protocol is an opportunity to update cropping technologies.

7.2.4 He also briefly discussed the current critical use exemptions (CUE) concept, and explained how the Parties were currently following the process to the Montreal Protocol.

7.3 Session II: Alternatives to methyl bromide in the commodities and durable sector

7.3.1 Dr. Jonathan Banks started his presentation on Summary of MBTOC 2002 Assessment report on alternatives with a recent photo of the ozone hole and explained that this forms the context of the work that is being done to phase out MB.

7.3.1.1 In a review of MBTOC 2002 Assessment, he says that 93 percent of controlled MB uses have alternatives available. He proceeded to describe durables to as generally dry foodstuffs, while non food durables include timber as raw wood, and also as timber packaging, cotton, machinery, etc. He also described general MB use, its advantages and strengths especially in terms of fumigation, and particularly how it is applied on durable commodities. The challenges for article 5 countries are to develop, register and use alternatives before phase out, and to meet the interim control measures for MB phase out under the Protocol. In his presentation, he also mentions that current proposal of the EU on further interim reductions on MB to be tabled at the November MOP. In particular, he also gave the participants an insight on the amount of information available on alternatives, by providing references for alternatives to MB citing particularly MBTOC reports, publications from research institutions, and some UNEP publications.

7.3.1.2 According to Dr. Banks, there are technically feasible alternatives to MB for almost all non-QPS treatments for durables. He said that the committee identified only fresh chestnuts, some dried fruit, and some flour mills that need MB. He have an overview of the use of phosphine in countries, and the problems faced such as the development of insect resistance, and stressed that
despite this, there are also non-MB alternatives that can be used other than phosphine. However, he cautions that each has to be situation specific. Heat or cold can be rapid, sustainable and residue-free. There is already approved process for timber (56 degrees for 30 minutes), and most quarantine authorities will approve this as a quarantine measure.

7.3.1.3 In kind alternatives such as carbon bisulphide, Co2 and CA, dichlorvos, ethyl formate, ethylene oxide, hydrogen cyanide, PH3, propylene oxide, sulfuryl fluoride were also described. He gave examples where these are used in countries within and out of the region. He also mentioned that some of these alternatives listed are not all registered for use in many of the countries that need them, thus making some countries continue the use of MB. Avoiding the need for fumigation altogether is a not-in-kind alternatives to fumigation. Some examples in this area are IPM/ICM/heat treatments, irradiation, pest removal and exclusion, and some pesticides (more organophosphates and pyrethroids). Constraints to adoption of alternatives include registration issues, for new chemicals they need new registration, for some older ones, these could have lapsed and need to be re-registered.

7.3.1.4 During the discussion, one of the main questions that was again raised by the participants was how to identify QPS use, and what kinds of survey can be done in order for such information to be collected. Joining Dr. Banks in his response, UNEP mentioned the recent assistance provided to Malaysia where a survey questionnaire was prepared to assist them to get this information. The important thing that was also mentioned was the need for cooperation between the MB importers and the NOUs, and the Departments of Agriculture in each country as this will ensure a broader collection of data.

7.3.1.5 The other issue that was raised was how far insect resistance to phosphine is affecting this region. It was suggested by the participants that perhaps UNEP could initiate a survey to see this. This information was deemed important in order to see what specific actions can be done to solve this biggest obstacle to the use of phosphine.

7.3.2 Phosphine as the main alternative to MB in the commodities and durables sector. Dr. Jan van Graver, CSIRO, Australia

7.3.2.1 Dr. Jan van Graver of CSIRO Australia made this presentation. He used a number of charts and diagrammes for his presentation, and emphasized that for phosphine, the most important element of fumigation is time, as compared to MB. He mentions that this is also one of the reasons for some failures in fumigation using phosphine occur, as shortcutting on exposure time could cause economic losses for exporters.

7.3.2.2 He mentioned that alternatives should be effective, cost-effective, rapid-acting, and fit within existing logistics systems (ie. grain handling). Categories of alternatives are existing and potential, and slow-acting or rapid acting. Phosphine is a slow acting fumigant, while MB is fast acting. For many fumigators certain situations necessitate the use of fast acting
fumigation, while in many other cases, if a fumigation is well-planned, a low acting fumigant such as phosphine can be used without any problems.

7.3.2.3 He compared the fumigation properties of MB and phosphine, and emphasized the need for training of fumigators on how to use phosphine properly and correctly, looking more at correct exposure periods, and the need to prevent leaks. It is also essential to measure the gas concentrations as part of a good monitoring process otherwise the fumigation will fail.

7.3.2.4 He also related that NOUs can play a specific role in phasing out MB and promoting the use of phosphine. These include: Identifying both existing and potential alternatives, establishment of a database for replacements, implement research to adapt alternatives to local requirements, harmonizing requirements for fumigation so that each alternative can be used for a specific purpose.

7.3.3 Experience of Vietnam in the use of Phosphine, Dr. Duong Minh Tu, Director, Central Plant Quarantine Lab, Vietnam

7.3.3.1 Phosphine use in Vietnam started in the 60s. There are currently about 10 fumigation companies in Vietnam, both joint venture and private limited companies, who run the fumigation work in Vietnam. The Plant Protection Department supervises fumigation in Vietnam.

7.3.3.2 Both MB and phosphine are listed as restricted chemicals in Vietnam, and both need import controls. From 2001-2003, MB imports are 179 tonnes, and phosphine is 72 tonnes. Vietnam is facing problems with illegal imports of phosphine from China because of its cheaper price.

7.3.3.3 In his presentation, Dr. Tu also provided details on the fumigation practices done in Vietnam, and showed specific concentrations of gases for specific applications. He mentioned that the use of phosphine is becoming more and more acceptable in the country, although for some rapid fumigation needs, they usually have to use MB. For them, one of the biggest constraints in the use of phosphine are still insect resistance, and the length of time required for fumigation.

7.3.4 Use of Phosphine in BULOG Indonesia. Dr. Haryadi, BULOG Indonesia

7.3.4.1 Dr. Haryadi commenced his presentation with a brief background on BULOG, the National Logistic Agency of Indonesia. BULOG is responsible for maintaining the national food stocks and responsible for stabilizing price of grain in Indonesia. Stores about 3 million tons of rice per year. It is currently responsible for purchasing bagged rice according to quality standards set, construction of bag stacks in warehouses both at regional and provincial level, and is responsible for quality management through regular inspection, fumigation, etc. BULOG has 1500 warehouses for rice each can accommodate 1500 tonnes. Each warehouse is uniformly constructed in the Indonesian archipelago. Generally phosphine is used in these warehouses for fumigation.
7.3.4.2 He explained in detail the method of fumigation that is done in BULOG, describing how bag stacks are stored, space requirements, and use of phosphine as a fumigant, and provided examples of phosphine concentrations in some stacks treated.

7.3.4.3 He also described the UNIDO demo project, describing the methodology for the project. This demo project used EcoFume with cotton sheet as protection, and MB as control for bag stacked rice. Aluminium phosphide tablets were also used for coffee and woods. The results of the demonstration project was good, and the use of Ecofume showed better uniform concentration of phosphine, and the cotton sheets were good as covers as these allowed longer intervals between fumigation.

7.3.4.4 Although the UNIDO demonstration project using phosphine was successfully implemented, and showed good results, BULOG is still facing difficulties in convincing higher authorities to use the demonstrated technology (using Ecofume) as a way to fumigate milled rice. Currently in Indonesia, traditional fumigation methods using phosphine are still being used. Mr. Haryadi is concerned that the lack of qualified trainers may not breed a new generation of good fumigators.

7.4 Session III: Good Fumigation Practices

7.4.1 Responsibilities of the manager and fumigator.  *Engr. Bailey Yu, Philippines*

7.4.1.1 The manager has a host of responsibilities in three main areas of the fumigation sector: business, technology, people and operation. In ensuring that fumigation is done properly, managers are also responsible for providing personnel training for the fumigators before they are allowed to go out into the field. In describing the responsibilities of the fumigator, Engr. Yu emphasized that the fumigator must hold a license from the designated licensing authority in the country, and must have the knowledge and understanding to implement Good Fumigation Procedures.

7.4.1.2 The above responsibilities include proper fumigation procedures, safety considerations for the fumigation, procurement of equipment, and must complete and furnish the necessary documentation related to a completed fumigation to the authorities.

7.4.1.3 The fumigator must be present at all times during fumigation, supervise his subordinates, and complete the whole fumigation process until all spent fumigant has been properly disposed of, following national environmental rules and regulations. Records of fumigations carried out also have to be kept carefully, including those documentation issued during the process. The licensing authority will often require these records, and poor record keeping could cause the cancellation of the permit.
7.4.1.4 It is also the manager’s responsibility to ensure that before a fumigator who is part of his company goes to get his license that he is well equipped with the knowledge and documentation needed for this to be obtained easily.

7.4.2 Sealing and sealing techniques for better phosphine use. **Dr. Jonathan Banks, MBTOC co chair**

7.4.2.1 Sealing the structures/storage areas where fumigation is to be done is an important aspect of a successful fumigation activity. Where phosphine is used as a fumigant, sealing is as important as when MB is used. In leaky structures, phosphine concentrations peak very fast, but gas loss is also as fast, thus fumigation failures are bound to occur. Sealing and testing whether the structure is completely tight and leak free is an important part of quality assurance. If sealing tests are not done, then there is very little confidence that the seal is as tight as it should be, and will keep the gas long enough for effective fumigation.

7.4.2.2 Pressure tests and tests for fumigants are sample tests that one can use to check for leaks in the seal. Simple pressure testing with a fan, timer and pressure monitor works as well, and costs much less than a phosphine monitor.

7.4.3 What makes good fumigation? **Jan van Graver, CSIRO, Australia**

7.4.3.1 This presentation identified the various stages/procedures in the fumigation process paying particular attention to certain aspects of the treatment where potential carelessness could cause fumigation failures (i.e. sealing, leaks, dosages of fumigant, monitoring fumigant concentration, etc). Each of these specific parts of the process was described in detail and the solutions to each potential problem were discussed.

7.4.3.2 For example, in case of small stores and where phosphine formulations available are higher than the dosages needed, Dr. van Graver suggests overdoing rather than using a lower dose. Likewise, for structures that have leaks in them, he also advises that it is very important that these leaks be covered up before fumigation is done.

7.4.3.3 The use of equipment to monitor phosphine concentrations and pressure are necessary, but these must be calibrated regularly in order to ensure that readings are accurate. Good fumigation is also a result of good management, not just good techniques.

7.4.3.4 **Open Forum:** Among the questions asked by the participants, one that emerged was a query on the cost of good fumigation. The experts suggested that the cheapest may not be the best, however, experience should also show what works for a specific structure and product well. The use of phosphine needs a lot of work and change of good practice.

7.4.3.5 India raised an important point on the often lack of involvement/cooperation between the official plant quarantine office in the country, and the private
fumigators. Although guidelines exist, often the implementation of these guidelines is slow or non-existent.

7.4.3.6 China described that grain storage in their country is subsidized, so the financial benefits are small, although it pays to reduce cost, as this is an important factor to ensure continued subsidy. Fumigators do not need to have licenses in China, and perhaps this type of quality control will need to be established soon.

7.4.3.7 Some participants raised that the presentations made by experts are typical of ideal situations, and are often difficult to apply in most countries. Others countered that obviously, the ideal situation should be the best standard when following approaches and methodologies, otherwise all the work will be mediocre. Some also raised the fact that when compromises have to be done in some of the steps fumigation, this could be disastrous for the products, and losses will be incurred in doing that (i.e. confidence, failures in fumigation, etc). Others also raised questions on whether one should look at the perfect process, of the practical one that can be applied easily. The experts explained that there are specific steps in the fumigation process that need to be done in order to ensure its success. Shortcutting these is alright if this is done through innovative ways, for example, as long as gas concentrations are monitored, one does not need to use expensive gas monitoring equipment, but can improvise. The bottom line is that these steps should not compromise the final outcome of the fumigation process, which will be possible pest break out.

7.4.4 Various formulations of phosphine and their best uses. Jan van Graver, CSIRO

7.4.4.1 This presentation on the various formulations of phosphine was done using the “show and tell” way. Dr. van Graver had examples of the various phosphine formulations, in tablets, powder in sachets, in packets, blankets, and in special formulation that needs a phosphine generator. Phosphine gas comes in cylinder. He specified that each of these formulations have very specific uses, and each have different exposure times. The use of these different types also necessitates specific safety measures to avoid the toxic fumes.

7.4.4.2 The main phosphine manufacturers are in India (3), China (7), and some in Brazil.

7.4.4.3 He went on to show, through a video, how each of these can be used. For example, pellets/tablets can be used for small bag stacks, as these are cheaper and are more available. Each of the blankets, and powder sachets also come in specific concentrations, and the number to be used will depend on the size of the area to be treated. The video also illustrated good phosphine fumigation practices. A video was shown to illustrate good phosphine fumigation practices. Gas tightness and good gas circulation are important aspects of the fumigation process that should not be overlooked.

7.4.4.4 In response to a query from Fiji on the fact that they have small stores, and that aluminium phosphide formulations are often too big for their needs. Dr.
van Graver suggests that they should overdose rather than underdose, and throw out the remaining phosphine that is not needed.

7.4.5 Causes and management of pest resistance with phosphine use. Dr. Banks

7.4.5.1 The single most severe threat to the continued practical use of phosphine, which is causing increased use of MB in many cases, is insect resistance. Resistance is caused by inadequate fumigation. Insects are vulnerable to resistance at various stages in their life cycle. In most instances, eggs and pupae are the most tolerant, however there are now several strains of adults that are also tolerant to phosphine.

7.4.5.2 Dr. Banks illustrated 3 methods to test resistance, the FAO method, which is quite complex, the Reichmuth method, which is easier but does not give quantitative data, and the time-to-extinction method, which is slow and laborious but quantitative. He mentions that for individual fumigators, the Reichmuth method works best.

7.4.5.3 He also mentioned specific measures that one needs to ensure when using phosphine as a fumigant, to have a successful fumigation:

- improve gas tightness
- decrease frequency of fumigation through other counter measures
- cool drain after fumigation to extend the life cycle of survivors
- adjust dosages
- maintain concentrations for longer periods
- ensure even distribution of PH3
- spread rational and correct standard to assess success or failure of fumigations

7.4.5.4 A question was asked on what to do with imported resistant strains of pests, especially those that are not classified as quarantine pests. Asia has more resistant sitophilus than Australia for example. He suggests that these pests should also be eliminated.

7.5 Session IV: Roundtable Discussion -- experiences of the participating countries in the use of phosphine as an alternative

7.5.1 For the round table discussion, each country representative was given ten minutes to describe how phosphine is being used in their country, if at all, and the prospects for broader use in the future.

7.5.2 Mr. Li Fujun of the China Grain Storage Board said that average grain stocks in China are 200-250 million tons annually. They also have national fumigation standards for both phosphine and methyl bromide. Phosphine is used on 80 percent of grain storage in China because it is easy to use, cheap, versatile and acceptable to a large clientele. In China at present, this is the fumigant of choice for stored grain.
7.5.3 However, he related that despite this acceptance, many grain stores have to fumigate with MB as an alternative to phosphine due to problems associated with it. These problems include:
- Pest resistance
- Ineffective use of PH3 as fumigant (more pests have emerged?)
- Cost of phosphine fumigation is increasing (due to need for increased dosages because of resistance).
- Safety and risks
- Some areas not suitable for PH3 fumigation

7.5.4 He feels that once the above issues can be resolved, there will be no need for China to use MB in grain storage.

7.5.5 Fiji mentioned that they have also been using phosphine for sometime now, but that fumigation is normally carried out according to the bilateral agreements that their country has with the importing country. This means that if MB is specified as a fumigant, they will have fumigate with methyl bromide. Ninety percent of the fumigation in Fiji is for durable crops, and most of these potentially fall within the QPS definitions.

7.5.6 Fiji does not have existing fumigation guidelines, but follows well known international guidelines such as that from ACQUIS and the FAO. The Government also does not have regulation for the use of phosphine so it is the main responsibility of the fumigator to promulgate their own job instructions, etc, also following accepted international standards.

7.5.7 The main constraints being faced by Fiji on the broad use of phosphine as a fumigant includes the following:
- No proper fumigation chamber, lack of equipment to monitor phosphine concentrations
- Longer exposure time
- Uncontrolled doses
- Disposal of residues
- No proper fumigation guidelines nor controlling authority
- Need for more training

7.5.8 Fiji believes that with more training and the early establishment of fumigation guidelines, the prospects of using phosphine will increase.

7.5.9 India stated that even if it is a largely agrarian country, MB has never been used in foodstuff. Most MB use in India is for QPS use only.

7.5.10 India is a manufacturer of phosphine both for domestic and export purposes. Between 1998-2002, domestic phosphine use was approximately 1500 MT, while the volume exported was around 500 MT annually. The manufacture, import and export of fumigants are controlled under the Insecticides Act first promulgated in 1968 through its rules and regulations issued in 1971. These rules are amended as necessary.
7.5.11 For the most part, especially for grain fumigation, phosphine is used in India, hence the large percentage of its manufacture goes to domestic use. The representative of India mentioned that although the volume of phosphine use is quite high, there have also been problems associated with its use, and these are mainly insect resistance.

7.5.12 BULOG is the biggest phosphine user in Indonesia. They have 90 registered fumigation companies in the country, but only 90 are active.

7.5.13 In Malaysia, the fumigants registered by Malaysia Pesticide Board are MB, PH3 and Dazomet. Currently, there are only two suppliers of MB registered in the country. This should make it easier to monitor where MB is being used.

7.5.14 The increased use of MB in the country is due to export of timber and wood products, pre-requisite prior to export and more stringent quarantine procedures from both the Ministry of Agriculture and Ministry of Health, including the systematic surveillance of warehouse premises and grain stores to monitor whether infestations occur.

7.5.15 According to a recent survey done in Malaysia, Non QPS use of MB is only 14.69 MT, while QPS uses are up to 167.33 MT.

7.5.16 Both aluminium phosphide and magnesium phosphide are used in Malaysia, in 2001 higher magnesium phosphide use. The constraints to their continued and broad use include:

- Longer exposure times
- Corrosive properties

7.5.17 The representative of Pakistan presented information related to the volume of their MB use. He also stressed that as far as they are concerned, the use of MB in Pakistan is for QPS only, and this is what the results of a recent survey show. Regarding their current situation of potential non-compliance, he mentioned that they are currently preparing a report for the Ozone Secretariat showing the results of their survey, and requesting for a change in their consumption to reflect QPS rather than controlled MB use. The new figures will put the country within their baseline, and potentially take them off the non-compliance list.

7.5.18 Regulation of MB use and even phosphine use in Pakistan is the responsibility of the Department of Plant Protection.

7.5.19 The Fertilizer and Pesticide Authority (FPA) is the regulating body in the Philippines for pesticide use since 1977. The representative reported that only licensed fumigators and pesticide applicators are allowed to handle toxic pesticides including the fumigant methyl bromide.

7.5.20 In the past, MB use was quite high, but these were more in QPS applications, as soil applications decreased due to use of telone as an alternative. MB is still used in tobacco plantations and flour mills.
7.5.21 Phosphine imports in 2002 was 17 MT, and increased to 20 MT in 2003. Many of the grain storage and even pre-shipment applications in the Philippines use phosphine, but a number of constraints have been identified that limits its broad use. This includes the growing problem of pest resistance to phosphine.

7.5.22 It was also reported by the representative of the fumigators in the Philippines that there are a number of applicators that really specialize only on phosphine, and do not use MB. But for spot treatments where infestation occurs, they resort to MB use for that specific purpose. He also mentioned that in order to increase the viability of phosphine as an alternative, there is a need for extensive training of fumigators on good fumigation practices.

7.5.23 Thailand’s methyl bromide imports in 2002 are 800 MT. Out of this imported amount, 382 MT was used in 2003 for applications that required a phytosanitary certificate. The Department of Agriculture then defined this as uses falling within the official QPS uses.

7.5.24 Fumigation with MB normally through commercial contracts, not because of the need for a phytosanitary certificate, but for the most part, the requirement for the type of fumigation is included in the exporters letter of credit, hence this is done on a routine basis.

7.5.25 Thailand also mentioned that the World Bank is currently working with them to prepare an MB sector phase out plan, and this should provide survey results that will show how much real MB is used for controlled uses, and for QPS.

7.5.26 Phosphine use in Thailand is also quite extensive, but not as broadly as MB. The amount of phosphine used under the phytosanitary certification system is 16.5 MT for 2002.

7.5.27 Phosphine has been used in Vietnam since 1965 for control of insect pests in stored products, warehouses and ship holds. Both methyl bromide and phosphine are listed as restricted pesticides based on regulations from the Department of Agriculture, specifically the Plant Protection and Quarantine Authorities.

7.5.28 Between 2001-2003, total of 179 MT of MB was imported into Vietnam as compared to 72 MT of phosphine. Phosphine fumigation in Vietnam requires the completion of a certification paper for fumigation condition (CPFC), which in effect is like the phytosanitary certificate. Fumigation companies need to be registered with the Quarantine Authorities in Vietnam before they can issue CPFCs.

7.5.29 In Vietnam, phosphine use has been in combination with carbon dioxide, and this has been quite successful. Insect resistance to phosphine is also one of the reasons why they cannot really adapt its broad use. In order to find solutions, they are undertaking a number of research activities to study insect resistance in general, and for specific pests.
7.6  **Session V: Using the Grain Tutor Training Kit**

7.6.1 Jan van Graver walked the meeting through the Grain Storage Tutor, a CD-rom based training material that shows how proper fumigation practices are done for grain storage. The tutor is arranged according to modules that look at the various important aspects in grain storage including entomology of insects, how to set up proper fumigation facilities, how to do proper fumigation, and even includes guidelines and standards from ASEAN and AQUIS on the proper dosages for fumigation, applicable both to MB and phosphine.

7.6.2 The participants had an opportunity to do some hands-on work with the Grain Tutor using portable computers made available to them. Jan van Graver led this hands-on session, and explained to the participants how this training tool can be used. However, it was not possible to provide the participants with their own copies of the CD-rom at this time as copyright issues still need to be resolved with UNEP.

7.6.3 Haryadi Halid commented that in the process of translation, there is some information that could have been lost, and he requests if possible that these information be restored as much as possible.

7.7  **Working Group Discussions 2**

7.7.1 The meeting was divided into three groups in order to further discuss specific issues that arose out of the meeting. The main topics of each of the groups are the following:

- Group I: Phosphine as an alternative
- Group II: Institutional Requirements for adapting phosphine as the alternative of choice
- Group III: Policy and Regulatory Requirements

Guide questions were prepared for each group’s reference. These questions are attached as Annex ____.

In the Plenary session that followed, each group reported the following conclusions:

**Group I:** (Haryadi, Ismail, Srirakarn, Bailey, Mr. Hai and Jbanks)
- Proper fumigation techniques alone with phosphine will not reduce MB use, this should be supported with necessary regulation and policy
- Dosage and exposure time should be increased. Improve circulation techniques and proper bag stacks piling.
- Re-training for correct dosage rate and exposure time, sealing and circulation techniques. By 2004 and 2005

**Group II:**
- Need for real coordination within each country with various ministries and stakeholders, this is important and efforts should be made to improve this coordination.
Group III:

- Current polices and guidelines are insufficient to promote the use of phosphine and other alternatives to MB
- Need the following:
  - Harmonization of registration procedures to make alternatives readily available
  - Harmonization of procedures for application of phosphine at the local, sub-regional and regional level (minimum standards)
  - Support the use of alternatives by deregistration of certain uses of MB where alternatives are available
- Local minimum standards for each country for the application of phosphine, and this should be set for national, sub-regional, and regional levels
- Research should be in the areas of elimination of phosphine resistance, improvement of existing
- International agencies should support projects on research on alternative technologies and technology transfer.
- Networks?? For dissemination of information

7.8 Session VI: Practical and hands-on session on the proper use of Phosphine in containers

A field trip was made to the demonstration project site at

- Shown how to sheet stacks, pleating and folding at corners, laying of sand snakes. Practical tips on what needs to be done especially for sharp corners where ripping could be possible, and gas tightness will be compromised.
- Sealing techniques for application of phosphine pellets.
- Demonstrated Cyrtec Ecofume technology, showing phosphine tank and CO2 tank
- Showed various equipment used in fumigation including masks, gas meters, gas concentration equipment.
- Showed pressure testing on containers, identifying where leaks are, and sealing when necessary. Brand new or old containers should both be pressure tested to check for gas tightness. Age of container does not guarantee gas tightness.

8 RESULTS, CONCLUSIONS AND RECOMMENDATIONS AND LESSONS LEARNED

8.1 The Conclusions and Recommendations (Annex 1) agreed upon during the workshop reiterated that phosphine is the most important alternative of choice for durable commodities. However, insect resistance and other constraints must be solved in order for the use of this to be more widespread and reliable in each country. Training on good fumigation practice was found to be an area that needed focus, likewise the importance of coordination between government regulatory agencies and fumigators to have consistent policies on what can be used during the fumigation process.
8.2 The meeting also recommended consideration that phosphine is already widely used, and that projects to be funded from the MLF should look at how these limitations on its use can be improved, rather than further studies on this substance as an alternative. The other area that the meeting considers important is the fact that reversion to MB use is possible unless these problems are solved.

9 EVALUATION BY PARTICIPANTS

An evaluation using a standard workshop evaluation form prepared by UNEP was conducted at the end of the workshop. Participants in general rated the workshop as “excellent” and the presentations as “very good”. Some comments for better improving future workshops included the need for having more updated data, that the field trip and the continuing discussion after could have been better scheduled.

Overall, the participants rating and comments showed that it was a successful workshop.

A summary of the responses is included as **Annex IV** of this document.
Annex 1:

Regional Workshop for Asia and the Pacific: Constraints and Solutions to the use of Phosphine as an alternative to methyl bromide for durable commodities
29 September – 2 October 2003

Conclusions and Recommendations

Phosphine as an alternative to MB in durables:

1. The workshop recognizes that phosphine is the most important alternative to MB in durable commodities and its broad use needs to be promoted through policy, legislation and education in countries in the region.

2. Phosphine is currently used widely as a fumigant, and it presents an alternative to MB in some situations. Generally, incorrect use of phosphine may give rise to resistance and other threats to its continued use as an MB replacement. In order to ensure the sustained use of phosphine it is essential that good fumigation practices be followed. Re-training of phosphine users needs to be done especially on dosage rates, exposure times, sealing and circulation techniques. Such training including allied equipment needs to be implemented urgently with the assistance of implementing agencies and bilateral agencies.

The meeting also expresses concern on the possibility of reversion to MB use in circumstances where phosphine resistance has become excessive.

Institutional Requirements necessary to make Phosphine the alternative of choice

1. Efforts should be made to improve coordination between government and private agencies concerned with fumigation in order to ensure that policies and regulations including monitoring and inspections are consistent among these agencies. The meeting recommends the set up of working groups led by the government agencies concerned with phosphine use as soon as possible.

2. The meeting recognizes the need for the support from senior decision makers on promoting the use of phosphine and other alternatives to MB that show satisfactory research/demonstration results. It recommends that high level awareness raising be given immediate priority so that the necessary political support can be organized through the local National Ozone Units with the support of implementing agencies.

3. Training and awareness raising are essential components to the successful and sustained use of phosphine as an alternative fumigant. Phase out projects in countries need to include such components to support investment projects to support the “phase in” of phosphine.
Policy and regulatory needs to ensure good practices in fumigation

The meeting recommends that the following be undertaken as soon as possible:

1. That there is a need for countries in the Asia Pacific region to work towards harmonization of registration procedures to ensure that alternative chemical options are made readily available for use in the region.

2. Minimum standards for the use of phosphine should be promulgated nationally, and harmonized sub-regionally and regionally in order to ensure its proper application.

3. The use of alternatives must be supported by de-registration of certain MB applications where commercially available alternatives are in use.

4. International agencies continue to support technology transfer and research especially in the areas of:
   a. Management of phosphine resistance of stored product pests
   b. Improvement of existing alternative technologies
   c. Development of new alternative technologies

These recommendations and conclusions are adopted by the participants to the Regional Workshop for Asia and the Pacific: Constraints and Solutions to the use of Phosphine as an alternative to methyl bromide for durable commodities held in Ho Chi Minh City, 29 September 2003-2 October 2003
Annex II

**Final Agenda**

Regional Workshop for Asia and the Pacific: 
Constraints and Solutions on the use of Phosphine as an alternative to methyl bromide for durable commodities

**Organized by UNEP-ROAP**

Hosted by the Government of Vietnam

29 September-2 October 2003
Ho Chi Minh City, Vietnam

**Day 1**

08:30-09:30 Registration

0930-1000 Opening Session

- Welcome Remarks
- Keynote Opening Address by host country Minister for Agriculture or Environment
- UNEP Opening Remarks
- Main Objectives of the Workshop

10:30-1100 COFFEE BREAK

**Session I** Methyl Bromide Phase out in Asia and the Pacific: status of compliance

11:00-11:30 Compliance situation of Asia and the Pacific Countries to MB Control measures under the Montreal Protocol and Methyl Bromide consumption trends and future use in the region

*Ms. Cecilia T. Mercado UNEP ROAP*

11:30-12:00 Demonstration projects using phosphine in the region and an overview of their results

*Alessandro Amadio, UNIDO*

12:00-12:30 Discussion
<table>
<thead>
<tr>
<th>Time</th>
<th>Session II</th>
<th>Alternatives to methyl bromide in the commodities and durable sector</th>
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<tbody>
<tr>
<td>12:30-14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00-14:30</td>
<td>Summary of MBTOC 2002 Assessment report on alternatives&lt;br&gt;(This presentation will include a segment on what to do if MB is unavailable and phosphine cannot be used)&lt;br&gt;Dr. Jonathan Banks, UNEP MBTOC co-chair</td>
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<tr>
<td>14:30-1500</td>
<td>Phosphine as the main alternative to MB in the commodities and durables sector&lt;br&gt;Jan van Graver, CSIRO, Australia</td>
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<td>15:00-15:30</td>
<td>Experience of Vietnam in the use of Phosphine&lt;br&gt;Dr. Duong Minh Tu, Director, Central Plant Quarantine Lab, Vietnam</td>
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<td>15:30-16:00</td>
<td>COFFEE BREAK</td>
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<tr>
<td>16:00-16:30</td>
<td>Use of Phosphine in BULOG Indonesia&lt;br&gt;Mr. Hariyadi Halid, BULOG Research and Development Centre, Indonesia</td>
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<td>16:30-1700</td>
<td>Discussion</td>
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**Day 2:**

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<tr>
<th>Time</th>
<th>Session III</th>
<th>Good Fumigation Practices</th>
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<tr>
<td>09:00-0930</td>
<td>Responsibilities of the manager and fumigator&lt;br&gt;Engr. Bailey Yu, Philippines</td>
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<td>09:30-10:00</td>
<td>What makes a good fumigation?&lt;br&gt;Jan van Graver, CSIRO, Australia</td>
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<td>10:00-10:15</td>
<td>COFFEE BREAK</td>
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<tr>
<td>10:15-10:45</td>
<td>Sealing and sealing techniques for better phosphine use&lt;br&gt;Dr. Jonathan Banks, UNEP MBTOC</td>
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<td>10:45-11:45</td>
<td>Use of phosphine in containers and ships&lt;br&gt;Jan van Graver, CSIRO, Australia</td>
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<td>11:45-12:15</td>
<td>Discussion</td>
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<td>12:15-1330</td>
<td>LUNCH</td>
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<tr>
<td>13:30-14:30</td>
<td>Various formulations of phosphine and their best uses&lt;br&gt;Jan van Graver, CSIRO, Australia</td>
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<tr>
<td>14:30-15:30</td>
<td>Locally available phosphine formulations</td>
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</table>
15:30-16:00 COFFEE BREAK

16:00-16:30 Causes and management of pest resistance with phosphine use
Dr. Jonathan Banks, UNEP MBTOC

16:30-17:30 Roundtable discussion on issues faced by countries regarding phosphine use
(Each country rep to make a 5-minute presentation on the amounts of MB used on durable commodities, how much phosphine is currently being used, and what is the potential for replacing MB with phosphine for all durable commodities application in their countries)

Day 3

Session IV : Using the Grain Tutor Training Kit

09:30-1030 Practical Tips on the correct application of Phosphine using the Grain Tutor
Jan van Graver, CSIRO Australia

1030-1045 Coffee Break.

10:45-12:30 Hands on use of the Grain Tutor training kit
Jan van Graver

Session V Working Group Discussions

13:30-1500 The meeting will be divided into 5 small working groups where they will discuss specific issues, and report back to plenary. Each working group will have a set of guide questions to work from

15:15-16:00 Plenary. Each group will have 10 minutes to make a presentation.

Day 4

Session VI : Practical and hands-on session on the proper use of Phosphine in containers

09:00-09:30 Objectives of practical sessions, and groupings
Dr. Jonathan Banks, Co-chair, UNEP MBTOC and Jan van Graver, CSIRO

09:30-1030 Briefing on the facilities of the Vietnam Fumigation Company
Ms. Lanh, VFC

1030-1045 Coffee Break.
10:45-12:30  *Working Session 1:* Jan van Graver will demonstrate to the group the proper methods of applying phosphine, focusing on the common mistakes made by fumigators and applicators

12:30-1330  Lunch

13:00-1530  Continuation of working session

1530-1545  Coffee Break

1545-1630  *Continuation of working session*

1630-1700  Open Forum/Discussion of what was learned during the working session

1700-1730  Closing of Workshop.

  Closing Remarks from:
  - UNEP
  - HMS
Annex III

Regional Workshop on the Constraints and Solutions to the Use of Phosphine as an Alternative to Methyl Bromide in Durable Commodities.
29 September – 2 October 2003
Ho Chi Minh City, Viet Nam

List of Participants

<table>
<thead>
<tr>
<th>COUNTRY/ORGANIZATION</th>
<th>NAME AND ADDRESS</th>
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<td>CHINA</td>
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<td></td>
<td>Mr. Liu Chunyu</td>
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<td>Mr. Li Fujun</td>
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<td>State of Grain, China Administration</td>
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<td>FIJI</td>
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<td>INDIA</td>
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<td>INDONESIA</td>
<td>Ms. Kusmulyani Sugiarto</td>
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<td>Mr. Hariyadi Halid</td>
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<td>MALAYSIA</td>
<td>Mr. Ismail Ithnin</td>
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<td>Mr. Chua Lee Seng</td>
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<td>PAKISTAN</td>
<td>Mr. Khalid Masood Ahmed</td>
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<td>PHILIPPINES</td>
<td>Mr. Joel U. Baun</td>
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<td>Engr. Cecile A. Hernandez</td>
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<tr>
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<td>Mrs. Vu Thi Nga</td>
<td>National Office on Climate Change and Ozone Protection, Ministry of</td>
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<td>Dr. Duong Minh Tu</td>
<td>Director, Central Plant Quarantine Lab, Department of Plant Protection</td>
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<tr>
<td>Mr. Nguyen Bao Son</td>
<td>Int’l Inspection Furmigation Js. Co.</td>
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<td>Mrs. Vu Thu Lan</td>
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<td><strong>UNIDO</strong></td>
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<tr>
<td>Dr. Alessandro Amadio</td>
<td>UNIDO – Vienna</td>
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Annex IV

MEETING EVALUATION RESULTS
Regional Workshop on the Use of Phosphine as Alternative to MB

1. What is your overall impression of the presentations?

![Bar chart showing overall impression of presentations]

2. Which presentations or sessions did you find the most useful and why?
   - Demonstration of the Grain Tudor, resistance of insect to phosphine.
   - Practical demonstration – Field visit
   - What makes a good fumigation
   - All because of knowledge & changing experience
   - All the papers (sessions) present by Jan van Graver.
   - Country report session
   - Gathering more information
   - All – contained relevant information presented well
   - Presentations by Jan van Graver
   - Everything
   - All sessions
   - Proper usage of phosphine is fumigation – because MB is being phase-out, phosphine is the most important alternative for MB
   - Technical information given by the resource persons is good
   - From point of view of a fumigator, I am interested in technical sessions: using PH3 properly, solutions to resistance, and further pressure on better policies
   - Sealed technical
   - Phosphine resistance
   - Session IV, V
   - How to do phosphine fumigation correctly and how to limited or prevent phosphine resistance of stored insect pests
   - Correct fumigation practice to prevent resistance

3. Were there presentations or sessions which you did not find useful and why?
   - None – all of the presentations were useful
   - Of course, useful

4. How do you rate the technical content of the presentations?

![Bar chart showing technical content rating]
5. What suggestions do you have about improving the usefulness of the presentations at future workshops?
- Technical of using phosphine for fumigation
- More document distribution in different techniques.
- The use of PH3 for soil fumigation.
- The use of PH3 for the ship consignment.
- Extended the time for presentation
- More examples of proven results that can have impact to participants in accepting & adapting the recommendations and suggesting
- Implement locally with support from government agencies concerned.
- Other alternatives besides phosphine should also be discussed at length.
- If possible, I’m very concerned with further studies achievement in finding alternatives or method using PH3
- Were Technical presentations should be included in the workshop agenda

Overall impressions of the Country Report

6. What is your overall impression of this workshop?

7. Did the brief country presentations on the use of phosphine in their respective countries show the prospects for broader use of this alternative?

If no, what information do you think was lacking?
- ICM, IPM, ISPM system for controlling the storage must be concerned.
- No sufficient data of project in been presented
- The enforcement of the regulation.
- Most of the country rep. mentioning the use of phosphine in durable commodity only.
- Countries not convinces with the available information and not much publication done on its use
- Data is lacking for QPS and Non-QPS
- Data on actual usage of MBr for non-QPS application are still inadequate. There knows this in order to see the prospect for border use of phosphine.
- N.A.
- Many countries did not indicate trends on use. Most country only provide data on use in previous year (2001)
Meeting organization

8. Time allocated for resource persons

9. Time allocated for discussion with resource persons

10. Time allocated for country report and presentation

11. Time allocated for discussion among network members
12. Logistics arrangements during the meeting (i.e. availability of presentations, etc.)

![Bar chart showing ratings of logistics arrangements during the meeting.]

Demonstration of the Grain Tutor

13. How do you rate the quality of the hands on sessions of the Grain Tutor?

![Bar chart showing ratings of hands on sessions.]

14. Did the Grain Tutor session provide you with specific technical information that will allow you to use PH3 correctly for grain storage?

![Bar chart showing responses to the question about specific technical information.]

If not, what other information do you require?
- If should have been distributed in advance (over by at least)
- However, there are still other alternative methods which is worth to be included in the Grain Tutor such as heat treatment could treatment, among other.
- N.A.

15. If you were provided free copies of the Grain Tutor, would this help in outreaching the positive advantages of using phosphine and other alternatives for grain storage?

![Bar chart showing responses to the question about free copies of the Grain Tutor.]

35
Field Visit/Practical Sessions
16. How do you rate the quality of the field visit/practical sessions?

17. Did the practical sessions allow you to see how phosphine use can be improved in your country?

18. Did the workshop meet its objectives of identifying the constraints and looking for solutions to enable the broader use of phosphine in the region?

If No, Please give reasons why.
- N.A.

19. Which aspects of the workshop have been particularly successful or useful and why?
- Practical information on phosphine use.
- Presentation sessions and practical sessions.
- Round table discussion more effective in gathering information and idea
- Using phosphine correctly, theoretical & practical, because of this information will strengthen the capabilities of the NOU.
- Finding out the constraints for phosphine use
- Convening this specific on time
- Developing recommendation for future
- All
- Everything
- Explanation on the proper usage of phosphine because that is scheduled to phase-out MB
- Awareness about the resistance to Phosphine and its correct and efficacious use
- We do have chances to tad more about technical issues and exchange experience, with technical constancy from Mr. Graver and Mr. Banks.
- Phosphine fumigant is a major fumigant which can be used for durable commodities
- Getting the message across that fumigation using phosphine need to be done correctly
20. Which aspects of the workshop should be improved and what are your suggestions for improving similar future workshops
- The resistance of insect to phosphine must be introduced about insect’s species.
- Demon Project reports has to be discussed to show problems alternative application.
- Another Techniques beside PH3
- Alternative to MB for Soil fumigation
- Alternative to MB for Cut flower
- Increase the country report sessions
- Increase the details of UNIDO funding project in each country and the promotion of the result of the project; send phase out of MB and the use of PH3 as the alternatives.
- Practical season – Somali be extended
- Involvement of other related participants.
- More examples
- Field visits
- None
- None
- None
- Member participants should encouraged to discuss more on technical aspects is on the case/dosages/exposure period for phosphine use
- I have attended the 1st in Thailand and 2nd in Vietnam. Everything is excellent, participants acquainted and neater of subject. Next one should put more pressure on policy / lawuaher concerning MBr phase-out and Phosphine use further application, please have a session to state alternatives to all MBr application
- None
- NIL