REGIONAL WORKSHOP ON METHYL BROMIDE ALTERNATIVES FOR POST HARVEST TREATMENTS IN EASTERN AND CENTRAL EUROPE

Hosted by the Government of Bulgaria in Sofia

28-30 May 2002

Global Environment Facility

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Division of Technology, Industry and Economics
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Organised by

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1. **Summary**

The Regional Workshop on Methyl Bromide Alternatives for Post Harvest Treatments in Eastern and Central Europe, organised jointly by the UNEP DTIE OzonAction Programme, and the National Agricultural Advisory Service, Government of Bulgaria, was held in Sofia, Bulgaria, from May 28-30, 2002.

The purpose of the workshop was: (i) to raise awareness among trainers, technical experts, methyl bromide users and other stakeholders about appropriate alternatives; (ii) to demonstrate how alternatives can be adopted; and (iii) to initiate the development of training strategies for promoting the widespread adoption of methyl bromide alternatives for post harvest treatments in Eastern and Central Europe.

The workshop was attended by:

- representatives from Eastern and Central European countries that consume methyl bromide for post harvest uses, including extension workers, food storage and food processing persons, researcher/scientists, policymakers from National Ozone Units and Ministries of Agriculture.
- Technical experts from the region involved in implementing methyl bromide alternatives.
- Regional/local agricultural and environmental organisations.
- Representatives from UNEP, MBTOC, UNIDO, the European Commission and Canadian private sector.

The participating countries were: Bulgaria, Georgia, Hungary, Latvia, Lithuania, Moldova, Poland and Slovakia.

The presentations and discussions during the workshop focused on the following issues:

- Up-to-date information on the methyl bromide issue, methyl bromide phase-out requirements under the Montreal Protocol and the EC, available methyl bromide alternatives for post harvest treatments and the results of demonstration projects carried out in the region.
- Identification of alternatives that are appropriate to replace post harvest uses in Eastern and Central Europe, with an emphasis on alternatives identified in demonstration projects even outside the region.
- Practical demonstrations of how alternatives work (phosphine, phosphine in combination with another alternative, heat treatments, etc).
- Tour of areas that use alternatives to MB.
- Initiation of the development of training strategies for promoting adoption of alternatives.
- Exchange of experiences and lessons learned in implementing alternatives.

2. **Background**

Methyl bromide is a fumigant that has been used to control a range of pests in agriculture and for disinfection of durable and perishable commodities. MB has four main uses worldwide, namely for soil/pre-plant treatment; commodity/post-harvest treatment of stored products; structural/vehicle disinfection and for quarantine and pre-shipment (QPS). Due to its powerful curative properties, no single, direct replacement has yet been identified. The basic alternative approach lies in taking preventive measures, sanitation and general prophylaxis. However, methyl bromide is also one of the
chemicals that depletes the stratospheric ozone layer, a protective shield that filters out harmful ultraviolet (UV) radiation from the sun. The Meeting of the Parties (MOP) to the Montreal Protocol called for the control of methyl bromide in 1992. In 1997, a global phase-out schedule for methyl bromide was established by the MOP, requiring that developed countries phase out methyl bromide by 2005.

CEITs fall into two categories - Article 5 countries (MB phase-out by 2015) and non-Article 5 (MB phase-out by 2005). Regardless of actual EC accession, all non-Article 5 countries from Central and Eastern Europe shall use an amount of MB for QPS, not exceeding their average consumption for the years 1996, 1997 and 1998. In 1999, approximately 321 tonnes of methyl bromide was consumed in 8 Countries with Economies in Transition (CEITs) in Eastern and Central Europe. Methyl bromide is predominantly used in this region as a soil fumigant in greenhouses and in open fields to grow crops such as peppers, tomatoes, strawberries and tobacco seedbeds. It is also used for stored product protection on grains and other commodities and for pre-shipment and quarantine treatments.

UNEP's Methyl Bromide Technical Option Committee (MBTOC) 1998 Report has identified alternatives for the vast majority of methyl bromide uses. Although no single, in-kind alternative to methyl bromide was identified, effective alternatives for Eastern and Central Europe involve the use of Integrated Pest Management (IPM) systems that utilise a combination of pest management techniques. For grain storage, the MBTOC has recommended a number of alternatives that include the use of phosphine, heat and phosphine combined, and carbon dioxide treatments.

3. Implementing Alternatives

Training and awareness-raising activities play an important role in promoting the rapid and widespread adoption of methyl bromide alternatives that will meet local conditions. At the small or medium farming level, the most appropriate training method should be a participatory approach, methyl bromide users are trained on the Integrated Pest Management (IPM) approach.

In Eastern and Central Europe, there is a need for training activities that present the range of alternatives available for replacing methyl bromide and demonstrate how these alternatives can be effectively adopted. Such an activity should be targeted to extension workers, methyl bromide users and researchers from the government who are involved in promoting the methyl bromide phase out.

This workshop provided an important opportunity for trainers and methyl bromide users in Eastern and Central Europe to learn about available alternatives for major post harvest uses and how they can be adopted. While the emphasis of the regional demonstration activity, which is part of this regional project, was in looking at alternatives for soil fumigation, other CEIT countries expressed the need to look at alternatives for post harvest uses. Alternatives that are currently being used in certain countries were used as examples, and discussions on the various alternatives proposed by the MBTOC for such uses were also covered. The workshop also provided a forum to further discuss the regulations by the European Commission (EC) in phasing out methyl bromide and promoting adoption of alternatives, to assist countries in determining how to harmonise their regulations with the EC. Participants shared experiences on implementing alternatives and examined potential training strategies for promoting adoption of identified alternatives.

4. Objectives
The objectives of the workshop were:

- To raise awareness among trainers, technical experts, methyl bromide users and other stakeholders about appropriate alternatives for the major post harvest uses of methyl bromide in Eastern and Central Europe.
- To demonstrate how alternatives can be adopted for the major post harvest uses of methyl bromide in Eastern and Central Europe.
- To initiate the development of training strategies for promoting the widespread adoption of methyl bromide alternatives for post harvest uses in Central and Eastern Europe.

5. Expected results

The workshop was organized to achieve the following results:

- To identify appropriate alternatives for post harvest uses in Central and Eastern Europe.
- To develop initial training strategies and train extension workers on methyl bromide alternatives.
- To focus the attention of users, mills, granaries, warehouse managers and trainers to MB alternative methods, techniques and practices in post harvest and commodities treatment
- To heighten interest in alternative post harvest treatments, practised around the world and the CEITs;
- To acquaint users/stakeholders with regulatory measures and requirements both under the Montreal Protocol and the European Community.
- To generate a Workshop Report outlining specific recommendations and actions for promoting adoption of alternatives.

6. Participants

The participants at the workshop were representatives of National Ozone Units, Ministries of Agriculture, Ministries of Environment and State Plant Protection Services, technical experts, extension workers, food storage and food processing persons, and researchers/scientists from the region involved in implementing methyl bromide alternatives. Participating countries were: Bulgaria, Georgia, Hungary, Latvia, Lithuania, Moldova, Poland and Slovakia.

With the exception of the host country Bulgaria, which had a far larger delegation, countries were largely represented by a delegation of three persons. It is worth mentioning that even countries, such as Hungary, who do not use methyl bromide for post harvest purposes, also sent a full delegation to attend the workshop to learn about alternatives, so as to avoid future methyl bromide use. There were 33 country participants from the Eastern and Central European region.

In addition, representatives from UNEP, UNIDO, MBTOC, the European Commission and an expert from Canadian private sector, sourced via Environment Canada, were present.

UNEP was represented by Ms. Cecilia Mercado (for part of the workshop) and Ms. Christine Wellington (for the full duration) from the Division of Technology, Industry and Economics, Energy and OzoneAction Unit, Paris, France.

UNIDO was represented by Dr Antonio Sabater de Sabates.
The MBTOC representative (UK) was Mr. Robert Taylor.

The European Commission was represented by Dr. Tom Batchelor from Direction General Environment, Brussels, Belgium.

The representative of Canada was Mr. Dean M. Stanbridge, Technical Director, of The Steritech Group Corp.

For the list of participants, see Annex 10.1

7. **Methodology**

The workshop was arranged in five sessions, four of which focused on the presentation of papers on:

- Overview of methyl bromide phase-out and its use in Central and Eastern European Countries,
- Methyl bromide alternatives for post harvest treatments,
- Constraints to the adoption of methyl bromide alternatives for post harvest treatments,
- Development of training strategies for promoting the use of alternatives to methyl bromide for post harvest.

Within the third session, there was a separation of countries into two working groups to try to identify specific actions to overcome constraints identified in implementing alternatives. The fifth session of the Agenda was in of itself a working session for countries to discuss training strategies and other activities needed to implement alternatives for methyl bromide in post harvest uses, having identified their constraints in the earlier working session.

Working group sessions always consisted of small group discussions using a pre-prepared table to assist their discussions, followed by a Plenary presentation of a group's findings. The first working group session within session three of the overall agenda, saw the separation of the participants into two groups of four countries, where each group created a list of activities needed to overcome constraints to the implementation of alternatives. In the second working session, which appeared as session five within the overall agenda, countries were allowed to go into their individual country groups to identify potential training strategies to promote the use of methyl bromide for post harvest treatments in their countries.

In the Plenary session that followed each of these working sessions, groups presented their findings, and summaries of their presentations were input directly into the appropriate summary table, which was projected on LCD projector so that all present could confirm that their findings were accurately recorded by the workshop rapporteurs.

The second day of the workshop was a field tour to visit a flour-processing mill of the SOFIA MEL PLC, Loulis Group, and a warehouse for stored tobacco of SOFIA – BT PLC, which showed off their methyl bromide-free factory operations and gave practical demonstrations on using methyl bromide alternatives. The field visit provided an opportunity for participants to see firsthand how alternatives are being used and to ask technical questions about how they could be adopted for use in their countries.
8. **Content**

The workshop involved presentations that provided the participants with a wide range of information about methyl bromide alternatives for post harvest treatments of stored crops, the advantages and disadvantages of using certain alternatives, and ways of optimizing the use of phosphine in particular. Participants were exposed to the sanitation approach that greatly decreases a plant's dependency on pesticides in general. Participants also had the chance to get a more in depth look at the EC requirements for methyl bromide phase-out, especially useful since 6 of the 8 countries represented (Georgia and Moldova being the exception) are on the candidate list of countries hoping to soon join the EC. On the second day of the workshop, a field tour was organized to visit a mill and storage warehouse using methyl bromide alternatives.

Small group discussions also took place on the third day of the workshop that sought to identify activities to overcome constraints to the adoption of methyl bromide alternatives, and to identify possible training strategies and other activities needed to implement alternatives on a regional/national level. Where possible, groups also identified agricultural organizations, training institutes and other stakeholders that should be involved in the training activities and follow-up actions to be taken.

### 8.1 Presentations

#### 8.1.1 Opening session

**Dr. Margarita Nikolova**, the Executive Director of Agriculture Advisory Service (NAAS) opened the workshop, welcoming everyone to the workshop on post harvest alternatives. She challenged all present to take advantage of the discussions that would be held and to take the information back to their countries to aid in the implementation of strategies. She spoke of needing alternatives to ensure the future of our planet, and of the necessity for everyone's full participation; but also suggested that the workshop is a good opportunity to develop new personal contacts and friendships. She wished participants the best and hoped that all would also enjoy the beautiful city of Sofia. She then declared the workshop open.

**Boyko Boev**, Deputy Minister of Agriculture and Forestry gave the keynote opening address. In his speech he covered the history of ODS in the world and the threat of the depletion of the ozone layer. He spoke about Bulgaria’s commitment to the reduction of ODS by the various government agencies and manufacturers of ODS. The Minister expressed his pleasure at the Government of Bulgaria being afforded the opportunity to help coordinate the workshop. He wished all participants a fruitful and successful conference.

**Cecilia Mercado** gave her opening remarks about the countries of Europe and their phase out dates and actions that need to be taken. She spoke about taking action sooner then later in order to meet deadlines of other countries within the same sector, and made reference to the earlier workshop held to demonstrate pre-harvest methyl bromide alternatives, going on to describe the opportunities, which exist in the Post harvest sector. She welcomed the extensive opportunities to meet and speak with the experts, who were in attendance. She named the key objectives of the workshop as being (1) to raise awareness, (2) how to apply the post harvest alternatives, (3) to look at developing training strategies. She stated that the success of these workshops is directly related to the level of participation of attendees during and after the end of the workshop. In closing, she thanked the
Bulgarian hosts of the workshop, the participating countries in attendance, and finally the experts present, and stated that she looked forward to a successful workshop.

**Dr. Kristian Kamenov**, Director of Science and Education Directorate, Ministry of Agriculture and Forestry, Bulgaria welcomed all to the workshop. He alluded to the significant body of work done globally in the area of post harvest alternatives to methyl bromide, and of the need to adapt this work to the region. He spoke of the Bulgarian commitment to organizing this seminar and he thanked the UNEP group for their facilitation of the exercise. He described the pride felt by the Bulgarian government in its successful effort to make the workshop a reality, and thanked Margarita for the efforts of NAAS. He looked forward to how NAAS would take the information from the workshop, and integrate what was learned into national programs.

### 8.1.2. Session I: Overview of methyl bromide phase out and its use in Central and Eastern European Countries

**Science of MB and Review of MB Phase Out Requirements under the Montreal Protocol**, by Christine Wellington, *(UNEP DTIE OzonAction Programme)*

This presenter reviewed the phase out under the Montreal Protocol in Eastern European countries. She gave a brief overview of the impact of ODS on the ozone layer, and the resultant negative effect on plants and animals. She then gave a description of what progress has been made to control the man made emissions of methyl bromide (MB), briefly describing: (1) the pertinent sections of the Montreal Protocol; (2) the categorization of countries by consumption; and (3) the fact that as a result of higher per capita consumption, all of the countries present, where placed into the non-Article 5 category within the Protocol, with the exception of Georgia and Moldova, who were deemed Article 5 countries. Participants were taken through the medium-sized umbrella project “Initiating the Early Phase Out of Methyl Bromide through Awareness-raising, Policy Development and training/Demonstration Activities”, highlighting the rationale behind the project structure and how the project outputs were designed to mirror the steps within any given National Action Phase Out Plan. The activities covered within the regional project to support the steps of a National Phase Out Action Plan were summarized as follows:

- **Step 1 - Assessment of Methyl Bromide Use**, which was carried out in the form of national surveys, which were ultimately compiled into a regional survey document on MB consumption;
- **Step 2 - Identification of Appropriate Alternatives**, which primarily took the form of demonstration projects to identify soil alternatives for Central and Eastern Europe for the cultivation of tomatoes, strawberries and peppers.
- **Step 3 - Encouraging Stakeholder Participation**, which involved the identification of stakeholders, and encouraging their participation in seminars such as the two training workshops for MB alternatives for soil and post harvest uses.
- **Step 4 - Establishing a Policy Framework**, where this activity was supported by a regional policy-development workshop, and a policy-mentoring service, which took the form of sponsoring regional experts to participate in key fora on policy.
- **Step 5 - Raising Awareness**, where countries were provided with funds for the production of regionally relevant technical brochures, and were provided UNEP publications on MB, case studies from the region, and information on agricultural sources.
- **Step 6 - Implementing Alternatives**, which although partially covered by the activity of the regional demonstration projects, should now be the next area of focus for countries, including the
development of investment projects to implement alternatives on a wide scale, and conduct further applied research.

She closed by reminding countries of the need for constant review of progress to see what has worked and what legal or institutional weaknesses may still exist. She urged the participants to concentrate on where they felt the priorities for future work in MB phase out may lie; and dispersed forms to evaluate the performance of the past project, and to give countries the opportunity to state their future needs to complete the phase out process.

**Overview of MB Use in the CEIT Region, by Dr. Kristian Kamenov**

This presentation was a review of the CEIT countries' survey results as reported in the Regional Survey report developed under the regional project. He presented succinct summaries of the data submitted by the countries, and described consumption trends, noting that Poland was the largest user, for both QPS and non-QPS (particularly in the area of soil fumigation) purposes.

Surveyed CEITs have their legislation in place, employing different regulatory instruments - ratification of MB phase out relevant MP Amendment, setting up a restrictive import/export licensing system, close quota monitoring, or imposing a high import tax (e.g. Slovakia). In 1999 all eight CEITs consumed a total of approximately 307 tonnes of MB - 43% Soils, 19% Durables, 7% Structures, 3% Other and 28% QPS. For the same year Poland (63 t), Lithuania (30 t) and Hungary (17 t) were the largest consumers of MB for QPS - 92% of the total. Bulgaria's consumption dropped by half since 1995 due to the ban imposed on MB use for treatment of stored grain and structures (equally effective, but easier to apply alternatives had been identified and registered) and limited soil treatment use. Pre-plant soil treatment with MB is employed only in Poland, Bulgaria and Hungary for vegetables, strawberries, fruit tree nurseries, ornamental plants, replants and tobacco seedbeds against fungal pathogens and nematodes. Almost all durable commodities, such as grain, dried food products, tobacco, cotton and herbs and a very small amount of perishables (Moldova) had been fumigated with MB, as well as structures like silos, mills and shipholds against weevil, beetles, mites, etc. Latvia and Lithuania foresee an eventual increase in MB use for treatment of rough and sawn timber (QPS) in favourable international trade conditions.

In general, he stated that soil fumigation was the largest use of MB amongst CEITs, but that this was changing, as most of the CEIT countries can now say since the start of the regional project, that they can now find alternatives for this usage. Most countries now have a permit program for methyl bromide usage. He reviewed the current usage patterns of each country and the cost average of methyl bromide. He overviewed the best alternatives that have been implemented, and stressed the need of countries to find funding for widespread adoption of MB alternatives in general. He spoke of the key organizations, both government and private industry, that are involved in methyl bromide, and described the efforts of the Bulgarian agencies in the reduction of methyl bromide. The main institution in Bulgaria that controls the usage of methyl bromide is the Ministry of Environment and Water, home of the Bulgarian NOU. They co-ordinate the efforts both in institutions and throughout the country. This group also created awareness brochures to distribute to the various sectors using MB. The Ministry of Agriculture was also recognized for their effort in the control and regulation of methyl bromide. He described the importance of each group being informed and presented several articles that have been published in various newspapers and research magazines that covered the use and elimination of methyl bromide. These articles showed the importance of the pressure from the press to ensure that alternatives to methyl bromide gain confidence in a country and are widely adopted.
Overview of Global MB Alternatives in Post-Harvest Treatments demonstrated/In Use with specific Emphasis on those treatments most appropriate for CEITs, by Mr. Robert Taylor, UNEP MBTOC, Natural Resources Institute, United Kingdom

The principal sources of information on progress made in the development of alternatives to MB are the reports of the MB Technical Options Committee (MBTOC) operating under UNEP, the reports of relevant conferences on MB, and UNEP DTIE. MBTOC compiles reports on the different uses of MB, and on alternatives and potential alternatives that will permit phase-out of the fumigant. Considerable progress has been made in the search for alternatives, although there are, as yet, few direct replacements for post-harvest and structural use.

Sources of information on alternatives: Reports of the MBTOC; Reports of the Technical and Economic Assessment Panel (TEAP); Conference proceedings and UNEP DTIE publications, workshops, etc.

Current post-harvest uses of MB, primarily for curative purposes: fumigation of food and non-food commodities eg. bulk and bagged grain, timber and timber products; fumigation of structures and vehicles including food-processing plants (mills), empty buildings, ships, aircrafts

Uses without alternatives to MB: fresh chestnuts; fresh walnuts for immediate sale; seed-borne nematodes; organophosphate-resistant mites in cheese stores; aircraft, where HCN is not available and quarantine and pre-shipment (QPS) - not currently a controlled use.

ALTERNATIVES AND POTENTIAL ALTERNATIVES

Fumigants: Phosphine (PH$_3$) - already widely registered and used for many purposes; Sulfuryl Fluoride (SO$_2$F$_2$) - used to treat timber, being evaluated for wider use, such as flour mills, not registered for food use; Carbonyl Sulphide (CoS) - under evaluation as a possible alternative to MB (not registered).

Other potential fumigants:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Use and present status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>Fumigant for grain where long treatment periods are possible</td>
</tr>
<tr>
<td>Carbon disulphide</td>
<td>Fire hazard, used now in China and Australia</td>
</tr>
<tr>
<td>Carbonyl sulphide</td>
<td>Experimental use only for grain and some other commodities, patent applied for in Australia</td>
</tr>
<tr>
<td>Cyanogen</td>
<td>Under investigation as a grain fumigant, patent applied for in Australia</td>
</tr>
<tr>
<td>Ethyl formate</td>
<td>Used to treat dried fruit, formerly used as a grain fumigant. Renewed interest in Australia as a grain fumigant.</td>
</tr>
<tr>
<td>Methyl iodide</td>
<td>Experimental use only, similar properties to MB</td>
</tr>
<tr>
<td>Methyl isothiocyanate</td>
<td>Experimental use only for grain and perishable commodities</td>
</tr>
<tr>
<td>Methyl phosphine</td>
<td>Experimental use only, has specific action against phosphine-resistant insects, UK patent application</td>
</tr>
<tr>
<td>Ozone</td>
<td>Laboratory use only against grain pests and some fungi</td>
</tr>
<tr>
<td>Propylene oxide</td>
<td>Used as food sterilant, under investigation as a fumigant for stored products</td>
</tr>
<tr>
<td>Sulfuryl fluoride</td>
<td>Used to control termites in the USA for many years. Potential use as fumigant for buildings and some food commodities under investigation.</td>
</tr>
</tbody>
</table>
Controlled (modified) atmospheres: Carbon dioxide - has slight fumigant action, high concentrations and well-sealed enclosures necessary, long exposures (2 weeks) essential; Nitrogen - no toxic action, oxygen level reduced to level below which insects survive (<1%), required exposure conditions identical to those for carbon dioxide. These have been tested in many areas and have been found to be very expensive due to the difficulties in generating on-site the large volumes of gas needed to treat large quantities of commodity, apart from the long exposure times required.

Contact insecticides are not curative and cannot be used to disinfest grain or other commodities, but could be applied as a preventive, especially in combination with fumigation to prevent reinfestation. Specifically described was the usage of pirimiphos methyl, which, though not effective as a curative solution, has some worth as preventative treatments, such as during the loading of silos with clean grain.

Physical control methods have been explored as alternative options. There is the use of cold treatment, where temperatures of -15°C or less required for rapid disinfestation; and heat treatment, where temperatures of 50-70°C are necessary. He predicted, however that extreme temperatures will have limited success in certain countries because of the extreme costs of either heating or freezing a facility or storage area. The use of inert dusts has been used in some areas, but this approach is not curative, but similar in effect to contact insecticides, and is most effective at low humidities. Irradiation experiments are taking place; but they are not acceptable in some countries, and irradiation is expensive. Finally he discussed vacuum treatment, which is mostly experimental at present, particularly in Israel, where they are using vacuum treatments as an experimental post harvest treatment of cocoa.

Biological control is a non-curative method, consisting of a long-term insect trapping. In combination with contact insecticides can reduce insect populations in stores.

Physical Barriers can be used to protect stored products, where, for example barriers such as cotton sheets, perhaps treated with a contact pesticide, can deter pests from infesting products that are in storage. Examples of a demonstration in Indonesian warehouses were cited to support his case.

Integrated pest/commodity management (IPM) is not a direct substitute for fumigation, but can reduce or help avoid the need for fumigation. Its components include better sanitation/inspection and some chemical use. Integrated Pest Management, whilst never a direct substitute for fumigation, holds promise if combined with other procedures, to decrease the amount of methyl bromide used.

Relevance of alternatives to MB to countries of Central and Eastern Europe: Constraints to the introduction of alternatives to MB for post-harvest and structural fumigation are, to some extent, universal and unlike alternatives for soil treatment are not nearly so affected by regional variations. Phosphine, for example, can be used in almost any country, with only the variable of temperature significantly affecting its use. This presenter raised the constraints and challenges of the expensive registration of new chemicals for use on food products, elaborating in particular the case of the sulfuryl fluoride and carbonyl sulfide, which are not yet registered in most countries. He highlighted the fact in particular, that the extensive battery of toxicology tests necessary for a chemical to be registered for use on food products is prohibitive for many countries. Most chemical companies will only take on the expense of chemical registration, provided they can be guaranteed a sufficient regional or global market through which they might recoup their investment. The fumigation of flourmills and other food processing facilities is a use of MB for which an alternative is urgently
required. The use of IPM strategies may be one option in some situations, but the urgent need for an alternative fumigant is acknowledged. It is hoped, that the fumigant sulfuryl fluoride will be able to supply this need, field trials having already been completed in the USA and in several European countries. Local registration of this chemical would definitely be needed before it could be used in any particular country.

Financial constraints may preclude the adoption of some alternatives that have high-energy requirements, such as the use of heat or cold technologies. In addition, high-energy requirements may be unavailable in some remote areas. Carbon dioxide is another example of an alternative that may not be suitable in many countries, because very large quantities are required for fumigation purposes, rendering it too costly or possibly unavailable.

Conclusions: MB fumigation is primarily a curative process and only those alternatives that satisfy this requirement can be regarded as direct alternatives. At present, there are a limited number of alternatives to MB, that might be substituted for the purposes of disinfesting durable commodities and structures. Where conditions are suitable, phosphine could be more widely used, and in due course alternative fumigants such as sulfuryl fluoride may become available for specific uses, including the treatment of flourmills. The enormous cost to chemical manufacturers of obtaining the data enabling registration of new fumigants means, however, that few new fumigants are likely to become available. It is likely, that non-chemical methods, including greater use of IPM strategies will be employed in the future to replace MB fumigation. The main purpose of many of these techniques, however, is preventive, not curative and they cannot be employed in situations where commodities or structures are already infested, and need to be disinfested. Many, if not all of the alternatives to MB that become available will be applicable to Eastern and Central Europe, and constraints to their adoption are likely only to be high cost and small market share limiting the possibilities for registration. Some alternatives that have been proposed, such as controlled atmosphere treatments, may not be acceptable commercially, because of the very long exposure period that is necessary compared to treatment with MB. Other technologies that are proposed, such as the use of irradiation, may not be acceptable to governments, or to the general public for safety reasons.

8.1.3 Session II: Methyl bromide Alternatives for Post Harvest Treatments.

The Use of Phosphine as a MB Alternative in Post-Harvest Treatments
Mr. Robert Taylor, UNEP MB Technical Options Committee, Natural Resources Institute, United Kingdom

The need to disinfest grain and other stored products using fumigation remains as important as ever, and the fast approaching phase out of MB has highlighted the continuing lack of replacement fumigants, or other suitable insect control technologies.

Phosphine as a post-harvest fumigant - This chemical is a globally used, relatively low cost fumigant product in post harvest applications, registered since 1963. Until relatively recently, phosphine was always applied from solid preparations of either aluminum or magnesium phosphide which generate the gas on-site, when exposed to atmospheric moisture. However, there are several different types of phosphine generation such as cylinderized phosphine, use of aluminium or magnesium phosphide tablets (magnesium phosphide gives a slightly more complete breakdown to phosphine on exposure to air), sachets and pellets, and phosphine generators. Phosphine gas can also be mixed with CO₂ or N₂ a fumigation tool. Phosphine is most effective as a fumigant in warm climates, temperatures of 15°C and above frequently being recommended as optimum. Providing
temperature range and exposure duration are optimum, it helps control all developmental stages of a wide range of insect pests, including the important grain pest *Trogoderma granarium*.

**Advantages of phosphine** - A principal advantage is the ease with which the commercially-available preparations, particularly tablets and sachets can be applied to even high-density stored products, such as grain and flour. When treating bulk products in situ, however, a recirculation system is necessary for better distribution and penetration of the phosphine. Thanks to the slight delay time between exposure of the metal phosphide and generation of phosphine gas, tablets have been even manually applied to bulk grain, although the use of an automatic dispenser is preferable. The relatively small phosphine molecule causes it to have more rapid and better penetrating properties than MB. It penetrates most packaging materials, including polythene, but not metals and dense concrete. Unlike MB, phosphine is not a very chemically active gas and does not form permanent residues by reaction with the majority of stored products that are fumigated. In addition, it is not adsorbed physically by most commodities likely to be treated. Application rates for phosphine are little affected by the commodity treated, but principally by the type of treatment, the prevailing commodity temperature and the presence of particularly tolerant insect species and their larvae (see Table below).

**TYPICAL DOSAGE RATES RECOMMENDED FOR PHOSPHINE AT 15-30°C**

<table>
<thead>
<tr>
<th>Type of fumigation</th>
<th>Recommended dosage(^{(a)})</th>
<th>g PH(_3) per tonne</th>
<th>g PH(_3) per m(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk fumigation in gas-tight silos</td>
<td>2 to 4</td>
<td></td>
<td>1.5 to 3.0</td>
</tr>
<tr>
<td>Bagged commodities under gas-proof sheets</td>
<td>3 to 5</td>
<td></td>
<td>2 to 3.5</td>
</tr>
<tr>
<td>In-bag fumigation</td>
<td>0.2g per bag(^{(b)})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space fumigation, e.g. empty store</td>
<td></td>
<td></td>
<td>1.0(^{(c)})</td>
</tr>
</tbody>
</table>

\(^{(a)}\) For control of *Sitophilus* spp., *T. granarium*, *Ephestia* spp., and mites, the highest dosage in the range recommended will be required, and exposures longer than the minimum given are likely to be necessary to control all developmental stages.

\(^{(b)}\) 50 kg bag. Equivalent to one pellet per bag.

\(^{(c)}\) For complete control of insects, structures being fumigated must be sufficiently gas-tight to retain a lethal concentration of fumigant throughout the exposure period.

**Limitations on using phosphine** - A principal disadvantage of phosphine is its much slower fumigant action compared to MB, resulting in the need for much longer exposure periods, rendering it unsuitable for QPS or other situations where time is a constraint. The slower toxic action results in a 5- day exposure period being advised for phosphine, as compared to a 1-2 day exposure for MB. In addition, there is need for extremely hermetic (airtight) conditions, due to the long exposure and smaller size of the phosphine molecule which can result in greater loss by leakage than when using MB. In achieving effective insect control a sufficient period of exposure to phosphine is much more important than gas concentration levels, and ct-products (concentration vs time ratios) as a measure of dosage does not apply. In general, the long exposure time must be accompanied by a tightly sealed fumigation enclosure to maintain a lethal gas concentration. Another disadvantage of phosphine is its limited effectiveness at low temperatures, making it suitable for use in temperate climates only in
summer. It forms an explosive mixture with air at concentrations above 1.79% at normal atmospheric pressure, but the concentration at which explosion can occur reduces at reduced pressure, so if phosphine is used in recirculation and vacuum chambers, this factor needs to be taken into account. Although not a very reactive chemical, phosphine does react with copper, silver and gold, resulting in possible corrosion, even at low relative humidity. There is a risk of damage to copper-containing electrical components, commonly found in mills and other food processing premises.

**Insect resistance and management: the development of resistance** - The issue of phosphine resistance in insects, was first observed in the 1970s in a laboratory-based evaluation of insects collected during a world-wide pesticide resistance survey. In 1982, reports of field resistance to phosphine were verified in Bangladesh, and later in other countries including Pakistan and India, and also in Africa and in Southeast Asia. Insect resistance to phosphine is now present on most continents but there have been few recent surveys, and the current global position is uncertain. The limited qualified genetic resistance found involves insects surviving for longer periods under phosphine exposure, due to repeated exposure to sub-lethal levels of phosphine. These resistant insects actively exclude phosphine from their systems for a time, such that now an exposure time of 5 days is recommended rather than the 2-3 days originally suggested before insect resistance was recognised. The term 'phosphine tolerant' rather than 'phosphine resistant' is now used as a result to describe such insects. However, some insects such as *Sitophilus* spp. are more naturally tolerant to phosphine than others and for this reason the term resistance is preferred. In developing countries, fumigation had been frequently executed by operators with little or no training. Poor sealing of the fumigation space, and/or short exposure periods resulted in insect populations often being exposed to sub-lethal concentrations. This permitted the selection of phosphine-resistant individuals, as in the case of the Khapra beetle, *Trogoderma granarium*, *Rhyzopertha dominica* and *Tribolium castaneum*. However, in most situations resistance could be overcome or avoided using phosphine, provided internationally recommended gas concentrations and exposure periods were maintained.

**Resistance management and avoidance** - It is accepted, that a major reason for the development of insect resistance has been repeated, poor quality fumigation. Avoidance measures include better sealing of fumigated enclosures and strict adherence to recommended exposure periods. The minimum exposure required is five days, and the minimum concentration of phosphine on the fifth day should be 0.2 mg/l. In developed countries there have been cases of resistant insects found in imported commodities - e.g. phosphine-resistant *Lasioderma serricorne* detected in tobacco from India, imported into the UK. The transport of resistant insect strains in infested commodities obviously poses a risk of transfer of such strains between countries and can only be prevented by better inspection and control programmes in exporting countries. Most recent reports from Australia indicate, that the magnitude of resistance in *R. dominica* there has risen to a level, where the most resistant populations could no longer be controlled using the registered dose and time protocols. Repeated use of low concentrations of phosphine (in combination with carbon dioxide in cylinders) and short exposures in flour mills in Hawaii has provided the right conditions, leading to suspected resistance in *Cryptolestes* spp.

**New formulations and application methods for phosphine** - The potential for applying phosphine gas from cylinders had been researched and developed mainly in Australia in the 1980s. The gas, usually 2-3% by concentration mixed with carbon dioxide is stored in cylinders, ready for direct application to grain or other commodities. The carbon dioxide acts as a fire suppressant and carrier for the phosphine. This method was developed to fumigate grain silos that were not gas-tight, whilst avoiding the selection of insects, resistant to the gas. In most countries, aluminum or magnesium phosphide formulations are registered as the source from which phosphine is obtained, and a constraining factor in widening the use of cylinder formulations has been the need to register
phosphine gas separately as a fumigant. This could also be a potential method for controlling insects in structural treatments. Cylinderised phosphine has also been investigated for the fumigation of bulk and bagged goods in transit by sea, very deep probing being used to ensure good gas distribution. An important advantage of cylinder-based phosphine is that the overall exposure period can often be reduced by up to 24 hours. The wider adoption of phosphine gas mixtures may be constrained at present, because the major manufacturer cannot meet the current demand in North America and the high cost of cylinders used to contain the gas, and which are unlikely to be returned by users in distant countries. This results in there being little, if any, incentive for the manufacturers to seek wider registration at present, particularly in developing countries. The possibilities of using cylinder based gas with on-site mixing of the phosphine with the other carrier gas such as carbon dioxide or nitrogen, has been shown to save on the import of ready mixed cylinders. Recently a new cylinder-based formulation containing phosphine has been developed in Germany. It contains 1.5% phosphine in nitrogen and is commercially available under the trade name 'Frissin', but it is not registered yet outside Germany. Other phosphine-generating devices currently under development include those based upon the hydrolyses of aluminum or magnesium phosphide. A stream of carbon dioxide may be used to entrain the phosphine produced, in order to carry it to the fumigation site and also to act as a fire suppressant. The most recently announced development of phosphine generators involves the use of a new formulation of aluminum phosphide, which is impregnated into wax blocks and currently is being evaluated in field trials. This new type of generator is unique in being activated by the addition of water, a practice never used with conventional metal phosphide formulations, because of the risk of explosion. Also mentioned was the horn generator, currently under experimental use in South America, which uses magnesium phosphide to generate and disperse very large quantities of phosphine.

Conclusions - Phosphine continues to be the only widely available and registered post-harvest alternative fumigant to MB. With the phase out of the latter fast approaching, even greater reliance can be expected to be placed upon phosphine. There are, unfortunately, specific limitations on phosphine, particularly the long exposure necessary and the higher temperature requirement compared to MB. Phosphine has already replaced many of the post-harvest uses of MB, however we may soon see the limit of this alternative as a replacement for methyl bromide. Phosphine is a highly valuable fumigant and it is unlikely, that any new fumigant will be as easy to apply, or have so little effect upon the product treated. It is essential, that this fumigant be used carefully, and that irresponsible use is kept to a minimum so as not to lead to widespread of resistance among pests.

Protecting Stored Tobacco with Phosphine
Mr. Doncho Obretenchev, Director, Institute of plant protection, Sophia Bulgaria and Ms. Antigona Vladovska, Director Leaf Tobacco Production, Bulgartabac – Holding Group, Sophia, Bulgaria

Bulgartabac's Elimination of Methyl Bromide - This company has successfully eliminated methyl bromide use in their facilities. There was pressure in the early 1990's to eliminate methyl bromide due to exports to large cigarette manufacturers who requested the elimination of the product, and this company representative described the difficulty in changing the mindset of staff within the facilities to use MB alternatives. This started with providing all of their supplier fumigation companies with extensive training in how to use magnesium phosphide. They then had to train and convince their own employees that they would have as much success with magnesium phosphide. There were some concerns with using magnesium phosphide such as the fact that they have to work within the temperature constraints, longer exposure times and having to make their warehouses more hermetic. This is especially a problem because to properly store tobacco, there needs to be lots of airing of the product, and because they could not afford to artificially acclimatize the storage area, they simply
made the structure open. Now with the need for hermetic conditions for phosphine fumigation, it is doubling the cost of operations.

Mr. Obretenchev, due to the language barrier, gave his presentation, "MB in Storage Pest Control", over to Mrs. Youlia Netcheva, in order that it be presented in English. She described the history of methyl bromide in Bulgaria, stating that MB was first used in 1961, with consumption increasing dramatically in 1965-1968. From the mid 1960s until 1990, MB was used widely in Bulgaria for soil fumigations, ship fumigants, seedlings, flowers and treatment of storage spaces, with the State-owned agencies monitoring the food processing plants and fumigation of stored cereal, such that 80-100 tones of MB was consumed annually. The product was considered essential and easy to use. She then described the concerns surrounding the elimination of methyl bromide. They have tried some alternatives such as direct raw material application of liquid pesticides before storage. They have tried the use of applied plant derived pesticides, but have found such botanicals to be preventive rather than non-curative option. She spoke of the difficulties encountered with the use of phosphine as a possible alternative, such as the inability to raise the temperature sufficiently for the fumigation of large stores during winter, the increased length of exposure and poor ability to seal the storage facility. She talked about the use of the “J” system, to try to improve the distribution of gas inside grain storage facilities. She spoke about the success of temperature extremes to control stored product pests, but only in small lots, where current technologies available permitted proper temperatures to freeze and heat. She spoke about irradiation as a control for small lots, but has found that irradiation has simply worked so far to sterilise insects rather than kill them. She recalled attempts to use inert dusts, but since 3-5 kg of dust are required for every tonne of grain, a large facility might require 10 - 17 tonnes of dust, and the exercise greatly compromised worker safety. She described the development of methodology to control various pests and spoke about some work to develop new varieties of wheat, maize, barley and bean, which will resist insect infestation. She concluded stating that although the cost of methyl bromide has increased over the years, it is still lower than that of MB alternatives. In addition, the consumption of MB in Bulgaria has fallen by 5 to 6 times from the peak consumption, so one often finds severe infestations, which they have been trying to combat with combinations of other insecticides (eg. organophosphates). They have also been considering the use of ozone as a sterilant, and the possibility of using methyl bromide recovery systems in storage facilities.

Mr. Dean Stanbridge, (Technical Director, The Steritech Group Corp, Canada). He concentrated on the IPM approaches to methyl bromide. He covered how to implement successful IPM programs into food processing and flour milling operations. He covered in detail how to set up a team approach to oversee the pest issues within facilities. He described cleaning techniques, structural issues and procedural changes that need to be implemented in order to be successful in this technique. He went on to describe pilot projects that have been successful at eliminating the use of methyl bromide. Some of these projects have been in use for over 6 years and all have 100 % eliminated methyl bromide from the facilities. He showed many pictures on good vs bad structure, practices and equipment design. He concluded that although most facilities have not kept careful track of the exact costs of this alternative, it is strongly believed that it is not expensive to implement. The largest obstacle is the training of the employees to clean at what he describes as “insect clean”. Other costs include possible increases in costs of equipment and structure through changes to improve sanitary design. These costs may be offset by savings in cleaning costs due to less cleaning time needed in improved designed facilities and equipment.
Question to R. Taylor with regard to the manufacturer of ECO Fume (phosphine and carbon dioxide mix). It was made clear that the manufacturers of the gas would not currently be pursuing European registration. Also question on the temperature ranges and exposure times that are required to ensure total control of insects. Mr. Taylor stated that although there have been no laboratory studies to show this, he felt that field studies have shown a minimum of 20°C for at least 5 days at a concentration of no lower than 150 ppm.

Question to D. Stanbridge about the cost of this method vs. fumigation. He answered that it is difficult to identify the exact cost due to the facilities being different. He believes that the cost increase is insignificant and he has said that some facilities have actually stated that the cost is less then that of fumigating.

8.1.4 Day 2: Professional field trip to the SOFIA MEL PLC, Loulis Group Mill, and the SOFIA-BT PLC Stored Tobacco Facility

The second day of the workshop consisted of a field visit to the Sofia MEL PLC, Loulis group flourmill and the Sofia-BT PLC tobacco storage facility. The flourmill is the largest in the Balkans and mills over 800 tonnes of soft wheat per day, yielding over 600 tonnes of flour. The facility built in 1986, is owned & operated by a large multinational corporation, and has processed approximately 2.5 million tonnes of wheat since it opened. The facility was very clean and state of the art with regards to all equipment and process control. The lab also exhibited the latest in analysis equipment. The pest control contractor for the facility, Unipest Ltd (Bulgaria), gave a demonstration and brief talk in the mill yard, to explain the Integrated Pest Management or IPM-based strategies they use for stored pest control at the plant. They use several formulations of phosphine, several formulations of other pesticides (including gels, powders), and different types of traps for pest control (including monitoring pheromone traps), and exhibited the method of use for the various pieces of applicator equipment and the like. As a result of Unipest's activity, the mill has not performed any methyl bromide fumigation since 1998. The mill has never had a case of infested flour due to the fact that all incoming infested grain is fumigated with an automated phosphine dispenser. Only 1200 tonnes of grain required fumigation in 2001. The Unipest representative summarized saying that the primary methyl bromide alternative at the plant, is a combination of improved cleaning techniques, insect monitoring and application of non-fumigant residual pesticides, and that at this time there is no evidence of insect issues within the facility.

The tobacco facility is a small, modern facility in where plant officials and staff gave a demonstration of phosphine tarp fumigation. The demonstrators applied a magnesium phosphine plate to a prepared section of tarped tobacco and showed how to take gas measurements. There was a short discussion about the use of phosphine to replace methyl bromide in tobacco storage facilities. This facility has not used methyl bromide since (1994). Phosphine is applied in temperature controlled areas and kept under gas for 5 days. This facility sometimes is required to store tobacco for two years. Tobacco insect activity is monitored by the placement of pheromone traps throughout the storage facility.

Dr. Tom Batchelor, European Commission. Mr. Batchelor apologized at his being held up at meetings in Brussels and went on to explain his role at the European Commission (EC) and the EC’s role in European ODP reduction. He covered the history of the Montreal Protocol and the European communities involvement on development of ODP regulations. He described the EC’s commitment to surpassing the requirements of the Montreal Protocol for MB users in Europe. The EC introduced inter alia earlier, greater reductions in MB consumption, a cap on the amount of MB that can be used for QPS, minimum qualification requirements for fumigators and a ban on the sale of MB in
disposable cans. The EC is scheduled to phase out MB consumption on January 1, 2005 for most uses. Non-QPS licensed use in the EC in 2001 was 6362 tonnes which was primarily in Spain, Italy, France, Belgium, Portugal, Greece and the United Kingdom. QPS licensed uses to be imported in the EC in 2001 were 713 tonnes. He went on to describe the challenges for finding viable alternatives. Although there are alternatives, they are still not being widely used. Many regions, however, do not have any further consumption of methyl bromide. This still means that greater effort needs to be placed in technology transfer, raising awareness for alternatives and continued research and registration of new pesticides. “Critical Use” exemptions will be reviewed and evaluated through a series of new procedures that are being developed within the Montreal Protocol. In 2003 there will be a review of the feasibility of accelerating the phase out schedule in developing countries.

Mr. Batchelor ended by congratulating the countries on their efforts at researching and implementing alternatives. He wished everyone continued success and looked forward to the remainder of the conference.

8.1.5 Session III: Constraints to the Adoption of methyl bromide alternatives for post-harvest treatments.

Short Country Presentations

**Bulgaria – Mr. Doncho Obretenchev** Use of methyl bromide in Bulgaria between 1991 – 1996 was approximately 100 tonnes per year, post 1996 has been approx 60 tonnes per year. Imports are currently from Israel. By the end of 2004 the goal will be 10 tonnes for QPS and 0 tones for NQPS. Alternatives include pesticides such as residuals and contact insecticides. Grain can be treated by alternative gases such as phosphine obtained from aluminum phosphide. Grain cooling has had good effect due to the cool winter climate. Additional cleaning has started to be implemented inside of structures. In addition, 3 wet treatments (Grain protectant with residual insecticides) per year are performed on grain storage.

**Georgia –** Georgia has had a steady decrease of use of MB until 1999 when there was a slight increase. Approx 10 tonnes or 49 percent was used for structures. Phosphine has been used for grain treatment at a cost of US$ 10-11 per kg compared to methyl bromide at US$ 7-8 per kg. There are a total of 4 large mills and 10 small mills. At this time there is a hold on projects. Would like to have some additional workshops to increase knowledge in the area of alternatives. Would like to see and alternative pesticide registered to replace methyl bromide.

**Hungary –** There is no registration uses for food products. QPS is permitted but has never been applied. Phosphine is the primary alternative since the late 1960’s for grain treatment.

**Latvia –** Methyl bromide is registered. The only structural use is grain elevators. Heat treatments are used as a primary alternative for wood products. No fumigation for soil. Peat is used as a substrate for soil.

**Lithuania –** Methyl bromide is only used for cereal grain treatments, elevators and storerooms. Some use is for museums and ships. Only one company is registered for importation and application. There are currently few alternatives used at this time. Alternatives of phosphine will not be effective due to the poor quality of grain structures. Grain facilities are currently not set up for treatment of grain with phosphine. Also, lack of information exists and further UNEP information sessions would be beneficial.
Moldova – Currently only use methyl bromide for QPS and only 1 tonne was used in 2001. Have used pheromone traps during post harvest in storage and milling facilities. These are used to monitor and trap low levels of insects. Pheromone trapping results are also used as part of the decision making process.

Poland – Used 15 tonnes for structures and commodities. Research has been done on phosphine, carbonyl sulphide and gamma radiation. Some work has been done on irradiation and IPM as alternatives. Constraints are seen as lack of registration of alternative products and too long of a registration process. Alternatives are seen to be more expensive and more complicated. A lot of additional training will be needed for farmers.

Slovakia - Current methyl bromide use is 0 tonnes for structures. Alternatives include aluminum phosphide products. The price of application of phosphine has been found to be very similar to that of methyl bromide. There are no barriers for economic reasons. Alternatives are, however, seen to have lower efficiency such as extra time and temperature. Methyl bromide was used until 1998 in structures. The only current uses are for QPS.

Overview on the Use of Economic Incentives to Promote the Use of Alternatives

Ms. Lidia L. Assenova, Senior Expert, Ministry of Environment and Water, Bulgaria

A variety of factors and incentives could assist and prompt the conversion of MB users to non-ODS alternatives, and there have been a number of positive global developments in the phase out process. They can be roughly divided in four main groups: technical, informational, legislative, and economic incentives. Ms. Assenova then proceeded to discuss the following categories of incentives.

TECHNICAL FACTORS: One of the reasons for the decreased consumption of MB in grain storage facilities and mills in some parts of the world is the availability of other substitutes with easier application. It is harder to work with MB, than with some alternative preparations. Besides, MB has adverse effects on a number of commodities, causing taint and odours. At the same time it is substantially phytotoxic and hazardous to human health. These factors further limit the use of MB.

INFORMATIONAL FACTORS: Public awareness is very important for the adoption of alternatives. It can include: seminars, publications, radio and TV broadcasts; manuals containing information about existing alternatives, scope of application, advantages and disadvantages; practical manuals describing in detail demonstration projects; technical booklets elaborating on the application of certain agricultural techniques; preparation of lists of companies who supply alternatives, including companies providing related services, such as pest identification, training in IPM and MB alternatives; detailed labels, etc.

LEGISLATIVE MEASURES: Most countries have introduced national regulations that restrict and phase out or prohibit the use of MB, have established provisions for critical use exemptions, and have set out the precautionary measures to prevent leakages.

ECONOMIC INCENTIVES: In addition to the technical and legislative limitations, there are a number of commercial and market limitations on the use of MB. A multilateral study identified the importance of market factors in the timing and success of ODS phase out. "The first primary factor affecting the phasing out relates to the markets for ODS technologies and the associated alternatives. Various market forces drive enterprises to stop using ODS. These include, for example, international
and domestic trade pressure and the prices of both ODS and alternative technologies. The nature and direction of these forces play an important role...". Several types of economic incentives were then described.

**Levies and Taxes to Fund Alternatives:** Some countries have levied taxes on ODS and pesticides in order to raise funds for the promotion of alternatives. Some governments have introduced such taxes as a step towards the implementation of the "polluter pays" principle.

- **An example of voluntary levy on MB**
  Australian MB users and importers introduced a levy on sales of MB back in 1995 to generate funds for introducing alternatives. At present the levy is about EURO 0.18 per kg and annually accumulates to approximately EURO 134 000, which is matched by funds from the government, giving about EURO 268 000 per year for the adoption and improvement of alternative techniques and communications with growers. In addition, increased prices have made alternatives more attractive for commercial use and increased the growers' acceptance of the need for research.

- **Taxes on ODS chemicals**
  Bulgarian legislation on the control and management of ODS, including MB, levied duties of about EURO 0.4 per kg on ODS imports. The revenue is used by the National Environmental Protection Fund for environment protection. Czech Republic's ozone protection legislation introduced duties of about EURO 6 per kg on imports of ODS, and the revenue is used by the state Environmental Fund for Ozone Layer protection. Based on the "polluter pays" principle, Denmark and Sweden levy environmental taxes on sales of pesticides in general, thus raising funds for research on non-chemical and IPM techniques.

- **Taxes on products**
  The TEAP study reads: "Market prices of goods produced using MB could be driven up to discourage demand by imposing specific products taxes. Such measures would require a means of differentiating between products, which have been produced or treated with MB and those that have not and a certification process for the proper implementation of a tax". MBTOC is not aware of any cases where taxes or levies have been placed on products grown using MB.

- **Tax rebate for alternatives**
  Some countries have reduced import duties and company taxes on non-ODS equipment and products to make investment in alternatives more attractive to ODS users. Malaysia and Singapore, for example, have granted reduction in company tax for firms who invest in ozone-friendly technologies. India has waived customs duties on imports of non-ODS manufacturing equipment.

- **Grants and subsidies**
  A number of governments promote agricultural innovations and export by providing grants or subsidies for specific activities. This could help determine farmers' choice of pest control methods, including MB alternatives. The regional government in Ragusa, Spain, for example, has introduced a programme promoting new agricultural technologies. They subsidize the purchase of plastic sheets for solarisation (25% of the cost is reimbursed) and machinery (13% reimbursed) to lay plastic for open field solarisation, as well as irrigation systems. The EU Common Agricultural Policy has several funding mechanisms that could be used to assist MB users in the adoption of alternatives, such as: grants for investing in farming methods, that reduce the polluting effect of agriculture, grants for training in agricultural environmentally protective and meeting modern requirements practices, etc. Several rural development programmes provide funds for advisory services, technical assistance and training, demonstration and pilot projects.

- **Others**
  Providing subsidies for the differences in income for using alternatives, introduction of programmes for crop insurance against the possibly higher risks for farmers, applying
alternatives, relieved credit requirements for firms introducing alternatives and "tax holidays" are other factors which may affect the introduction of alternatives.

Incentives Driven by Company Policies: This was another tool described by this speaker. Food manufacturers, traders and supermarkets can play a positive role in identifying MB alternatives, by reviewing their company policies and contracts, avoiding suppliers who use MB, and actively encouraging the adoption of alternatives. Some food manufacturers and supermarkets promote IPM programmes, which can have an impact on MB use.

- **Supermarket policies:** Several supermarket chains have adopted policies on MB: For example, Sainsbury's in the UK reported that its IPM programme did not permit the use of MB for certain crops, while in other crops MB use was limited. Some of Sainsbury's contracts specifically rule out the use of MB by suppliers. The Co-op supermarket organization owns a number of farms in the UK, and banned the use of MB as a soil fumigant on these farms in mid-1990s. The Co-op has announced a new code of practice developed with the suppliers, which will prohibit 24 pesticides, including MB as a result of rising consumer concerns about health and the environmental impact. Marks&Spencer has announced a plan requiring its suppliers around the world to reduce and phase-out the use of 79 pesticides that pose risks to health or the environment. MB is included in this list.

- **Policies of manufacturers, traders and auction houses:** Companies manufacturing food and tobacco products, wholesalers, auction houses and other trading companies often set conditions or specifications for product quality and other parameters in their contracts with suppliers. Grain importers, for example sometimes specify in commercial contracts that grain must be treated with MB before shipment. In several cases, manufacturers or traders have now ruled out the use of MB. Some tobacco companies have informed tobacco producers that they will accept no more post-harvest or pre-shipment treatments with MB. This is because MB can adversely affect the quality of tobacco and because of its environmental effect. Major flower auction houses in Europe successfully operate an environment quality scheme in which flowers are produced according to standards on pesticide use, water and energy waste. The scheme does not allow the use of pesticides that are not permitted, which eliminates the use of MB. In Spain, the association of Harvesters and Exporters of Fruit and Vegetables in Almeria has had 25 years of experience in intensive horticulture in the south – eastern part of Spain. From 1997, growers have been requested not to use MB, as a policy of the association and today MB is no longer necessary for production.

- **Company leadership in the commercialization of alternatives:** TEAP has highlighted the important role of companies who decide to take a leading role in the development and commercialization of non-ODS products and services. In 1990s in the USA, a pest control company took a leading role in trials and commercialization of MB alternatives for commodities and structures, such as food processing plants and flourmills. In Canada a food processing facility developed innovative and effective pest control systems based on sanitation, IPM and heat treatment, while the Canadian Pest Control Association has been strongly promoting IPM MB alternatives since mid 1980s. Certain governments actively encourage companies to take a leading role in ODS phase out. For example, US EPA holds an annual award ceremony for companies who show leadership in ozone layer protection.

Environmental Grading and Certification Systems:
This was the final tool described by this speaker. Industry environmental standards and certification programmes can assist the adoption of MB alternatives. For example, auction houses in the Netherlands have established an environmental certification and grade system for cut flowers, called
MPS, in which farmers reduce the use of pesticides, fertilizer, water and energy. MB cannot normally be used in the production of MPS grade flowers. Around 5 000 farms implement the MPS programme in 22 countries, including Netherlands, Belgium, Italy, France, USA, Kenya, Israel, Zimbabwe, Zambia, Costa Rica and Ecuador. “Eurepgap” standards in the European Community are promoting production of crops without the use of MB.

**ECO-LABELING AND PRODUCT INFORMATION:** The role of environmental labeling in consumer decision making on ODS, promoting the use of alternatives is significant. In the case of MB, some consumers and environmental organizations have pressed for the labeling of products, grown with or without MB, so consumers will be able to exercise a choice when they purchase fruit and vegetables. In several cases producers have placed labels on packages to inform consumers that MB has not been used. For example, in the USA, products, manufactured with ODS, with the exception of MB, are required to carry a special consumer label, which warns: “**Warning: manufactured with (name of ODS), a substance which harms public health and environment by destroying the ozone in the upper atmosphere.**” Some agricultural projects in Jordan have developed a certified label for IPM products, and those grown without the use of MB. When the MB label were trailed on packs of fresh strawberries, exported to supermarkets in Europe, retailer gave positive feedback and encouraged the producers to continue labeling products in this way. Consumer and environmental organizations in several regions have requested labeling so purchasers can exercise their right to choose. For example, the Food Commission, a consumer advocacy group in the UK, has asked supermarkets to label fruit and other products “**Grown without the use of MB**”

**THE SPECIAL CASE OF CEITs**

Unfortunately, many of the measures discussed above may be inapplicable in the CEITs. These countries neither have access to the special EU funds, nor sufficiently large own budgets to subsidise activities, stimulating the use of alternatives. At the same time, in some cases the preferential regime for goods and equipment, related to alternatives may contradict undertaken international obligations, e.g. free trade provisions. Such measures, related to duty and tax policy, set in Article 5 countries, are often inapplicable in the CEITs. For example, the import of goods and equipment using alternatives of ODS was exempt from duties and taxes in Bulgaria until 1997, but in that same year they were reintroduced due to changes in the legislation, in compliance with international obligations. The introduction of alternatives in the CEITs would be greatly enhanced by external financing. This should be directed towards demonstration projects, research of new alternatives and the subsidizing of alternative measures. Other groups of measures are related to increasing the awareness of consumers of the dangers of MB, as well as of existing alternatives, through special campaigns and the translation, publication and distribution of reference guides and brochures.

**Working Session 1: Specific Actions to Overcome Constraints Identified in Implementing Alternatives**

The first working group session, saw the separation of the participants into two groups of four countries (grouped as Lithuania, Bulgaria, Moldova, Slovakia and Poland, Hungary, Latvia, Georgia), where each group created a list of activities needed to overcome constraints to the implementation of alternatives.

In the Plenary session that followed, groups presented their findings, and summaries of their presentations were input directly into a summary table, which was projected on LCD projector so that all present could confirm that their findings were accurately recorded by the workshop rapporteur.
The main constraints identified by the groups fell into one of the following categories. These categories are further broken out in further detail in Table 1 that follows. The five main areas of constraints are:

- Technical Problems using alternatives
- Lack of knowledge on alternatives
- Cost of alternatives
- Training in the Use of Alternatives
- Effectiveness of Alternatives
<table>
<thead>
<tr>
<th>Category of Constraint</th>
<th>Description of Constraints Identified</th>
<th>Activities to Overcome Constraints</th>
<th>National</th>
<th>Regional</th>
<th>In need of Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Economic</strong></td>
<td>High prices for alternatives, technology and equipment</td>
<td>Levy tax on MB imports</td>
<td>Regional training of national trainers</td>
<td>Regional funding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of funding (all)</td>
<td>Subsidizing new technologies for alternatives</td>
<td>Study tours for trainers</td>
<td>From EC or other international funds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of finance in privately-owned mills and silos for introduction of new technologies/alternatives</td>
<td>Registration of more alternatives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subsidizing owners of the privately-owned mills and silos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Institutional (Policy/Legislation)</strong></td>
<td>Legislation development through existing systems (Georgia only)</td>
<td>Up to now suppliers request authorities to register products, but now importers should make the request to the government for registration</td>
<td></td>
<td></td>
<td>Information about producers, suppliers of alternatives – manuals, seminars and funding of registration</td>
</tr>
<tr>
<td></td>
<td>Discrepancies in agreements e.g IPPC/ICPM; WTO</td>
<td>Simpler registration procedures that are fast-track (= give alternatives to MB high priority for registration). Fee to registrant that pays for government authorities to evaluation new registrations for alternatives to MB.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complex registration process which is very slow in some countries</td>
<td>Regulatory authorities take the initiative to set up fast-track process for alternatives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Registration of alternatives</td>
<td>Better coordination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insufficient cooperation and coordination by authorities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>Lack of information about new alternatives</td>
<td>Develop procedures for implementing alternatives to MB</td>
<td></td>
<td></td>
<td>Access to EU and International funds</td>
</tr>
<tr>
<td></td>
<td>Lack of experience for implementing alternatives to MB</td>
<td>Developing programs for training stakeholders in the use of alternatives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of technological means for applying certain alternatives</td>
<td>Re-examination of guidelines guiding construction of agricultural and storage facilities.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Old and unsuitable facilities for applying some alternatives</td>
<td>Retrofitting and re-construction of existing facilities and equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Informational</strong></td>
<td>Lack of information and know-how</td>
<td>Preparation-translation of detailed technical manuals and brochures by sectors</td>
<td></td>
<td>Seminars workshops etc.</td>
<td>External financing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demonstration, research and investment projects</td>
<td></td>
<td>Share papers and Manuals where one country has expertise</td>
<td></td>
</tr>
</tbody>
</table>
8.1.6 Section IV: Development of Training Strategies for Promoting the Use of alternatives to methyl bromide for post harvest.

Dr. Antonio Sabater de Sabates, UNIDO Montreal Protocol Branch presented the importance of training and demonstration projects in the implementation of alternatives to methyl bromide. He gave an overview of the current phase-out demonstration projects and countries in which UNIDO is involved. UNIDO has implemented projects for a variety of commodities across the globe (eg. grains in Syria, dates in Tunisia, peanut seed in Senegal). In general, he stated that in order to be successful in training in alternatives, one must learn from others that have already done this work, and one must demonstrate the project to ensure its effect. You will need a good trainer to train farmers and others. There should be a maximum ratio of one farm leader for every 50 farmers in order to demonstrate the technology. Also, technical advice should be easily available. In the case of setting up a successful training program for MB alternatives in the fumigation of commodities, things become more complex, due to the added complications of fumigation of closed spaces, particularly in the area of worker safety. Some of the more crucial elements that should be included in training for alternatives in commodities fumigation were summarized as follows:

- Use projects to install monitoring and safety devices, as these are often lacking in facilities, and there are poor records of past infestation species and the like.
- Prepare simple but comprehensive and clear fumigation manuals.
- It is a good idea to start training exercises with one, short, intense one-day workshop for all supervisors, in effect carrying out the train-the-trainer approach. One good trainer can educate 40 others per year.
- Conduct demonstrations at each site and train factory staff on-site if possible to encourage the use of new technologies.
- Insist on fumigation monitoring and concentration records for fumigation. This is a crucial element for the maintenance of safety standards.
- Re-visit sites and check protocols and records to ensure good record keeping in general.
- Because training should be readily available and accessible, one must ensure that the trainer is well trained and available to all of the people as a source of information and training.

Legal and Technical Background for Introducing the Alternatives to MB in Post-harvest Applications in Poland

Mr. Ryszard Purski, Chief Specialist, Dept. of Environmental Policy - Ministry of Environment, Prof. Zbigniew Dabrovski - Academy of Agriculture in Warsaw

This team gave an extensive presentation. Mr. Purski gave the legal background for MB use in Poland, while Professor Dabrovski presented on the technical background of the introduction of MB alternatives to Poland. The main points are laid out below.

a) LEGAL BACKGROUND FOR INTRODUCING THE ALTERNATIVES TO MB IN POST-HARVEST APPLICATIONS IN POLAND

The introduction of alternatives to MB in post-harvest applications in Poland is subject to the Amended Parliamentary Act on Crops Protection of 12th July 1995, and its derivative Regulations. Two of these regulations, along with an Announcement of the Ministry of Agriculture and Rural Development, have been recently adjusted to correspond with the EU Directives, namely those concerning the fight against harmful organisms (adjusted 18th Sept.2001), listing detailed rules concerning the issuing of licenses for the registration of chemicals for crops protection to be traded.
and used (adjusted 5th March 2002), and on the annually reviewed inventory of chemicals acceptable for trade and use for crop protection.

The workshop was then taken through the Polish Act on Crops Protection, and the procedures and licenses needed to obtain and use an agricultural chemical.

Institutions concerned with crop protection in Poland are: the State Hygiene Institution, Environment Protection Institute, Plant Protection Institute, Plant Protection and Seed Production Inspection. Requirements for persons using chemicals for crop protection: users/buyers undergo a training course; sellers are required to have a list of buyers; trade with chemicals banned for unqualified people.

b) TECHNICAL BACKGROUND FOR INTRODUCING THE ALTERNATIVES TO MB IN POST-HARVEST APPLICATION IN POLAND

Next the Workshop was carried through Poland's history of MB use in post harvest treatments, and the introduction of alternatives into national use.

I. REASONS FOR THE HIGH USE OF MB IN POST-HARVEST TREATMENTS

Post-harvest grain handling in Poland 1985 - 1989.
1. The large state farms constructed 1,500 modern silos, total capacity - 2.07 million tonnes;
2. 13-14 million tonnes stored on private farms;
3. 40% of the grain was harvested traditionally - poor storage conditions, frequent fungi/insects/rodent infestations.

By 1990, the status of storage capacities (in thousand tonnes) was as follows:

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,870</td>
<td>Large state farms, Farmers' co-operatives, Seed companies (PGR, RSP, SKR)</td>
</tr>
<tr>
<td>5,660</td>
<td>Polish Grains Company (PZZ)</td>
</tr>
<tr>
<td>750</td>
<td>Animal feed, Consumption cereals, Oil &amp; Beer Industries</td>
</tr>
<tr>
<td>350</td>
<td>Rural Co-operative (GS)</td>
</tr>
<tr>
<td>10,630</td>
<td>Total</td>
</tr>
</tbody>
</table>

1992 - to present period: There have been many changes in cereal production, which have affected the post-harvest process, such as: (i) the restructuring and privatization of the Polish Grains Company; (ii) the establishment of new commercial companies for buying and selling grains; and (iii) a Government policy of interventional purchase of grain (80 tonne loads), which encourages farmers (producers) to form groups and follow special production/harvesting procedures (e.g. large bulks of uniform grade grain).

Still, present conditions of farm storages in Poland are such that:
- Only 50% of commercial farms (10-15 ha) have the potential to adopt modern technologies or have storage facilities meeting technical, phytosanitary and commercial requirements of proper post-harvest management;
- Despite cereal market deregulation, a number of farms are expanding and installing new silos (usually metal, cylindrical type) with a capacity of 10 - 1,800 tonnes;
- In 1996 - 11,800 farms had silos with a total capacity for storing 3,3 million tonnes, whilst 10,500 had silo capacities of 1,5 million tonnes;
- By 1997 15,000 new silos with total capacity of 901,800 tonnes were sold;
• By 2000 27,500 new silos with total capacity of 1,650,000 tonnes were sold.

II. POLAND'S NEED FOR A HOLISTIC APPROACH TO POST-HARVEST MANAGEMENT

These trends in grain storage, along with the fact that 80% of cereals are now harvested by combine rather than traditional methods have created improvements, as well as new challenges for storage. There is a reduction of direct losses to farmers, easier harvesting, and a shorter storage period; BUT there are also new challenges such as the fumigation of larger storage facilities, higher seed humidity, increased contamination of crops necessitating additional sanitation.

III. RELEVANT PAST AND FUTURE DEVELOPMENTS

A Law on the establishment and management of warehouses (Act 114/2000) has been passed, in face of the increased need for storage for corn and de-humidifying equipment (40% grain humidity during harvest). The corn crop in 1998 was 497,000 tonnes v. 1,375,000 tonnes in 2001, and there was also an increased need for storage of oil rape seeds -(2,400,000 tonnes in 2001). In addition, since Poland is planning to join the EU shortly, the EU Animal Feed Law must be adopted by 2003. The quality standards for animal feed and food cereals will be higher; and since no single direct alternative to MB has been identified, preventive and monitoring IPM methods, rather than direct chemical substitutions must be employed. Therefore Poland faces a significant challenge overcoming these challenges.

IV. BASIC RESEARCH ON THE MB ALTERNATIVES:

The presenter listed some of the independent research done in Poland, such as: (i) the effect of natural products on store pests; (ii) food attractants/repellents for the granary weevil (*Sitophilus granarius*); (iii) the role of 25 surface lipids & cuticular waxes of grains in the granary weevil oviposition; (iv) identification and composition of cuticular waxes of female and male beetles of *Acanthoscelides obtectus*; (v) the effect of volatile metabolites produced by the fungi on cereals (mushroom odour) and on the migration and food recognition by the granary weevil; (vi) biochemical factors responsible for differences in bean cultivars infestation by the bean weevil; (vii) the effect of irradiation treatments on the melanization of insect bodies of some quarantine pests; (viii) the effect of natural plant products on some stored product pests; (ix) neem seed powder and commercial neem products; (x) powder aerial parts of the ribbed melilot (*Melilotus officinalis*) and the white melilot (*M. albus*), Labrador tea and Sweet flag as repellents for the grain and rice weevil.

V. APPLIED RESEARCH IN POLAND

• Replacement of MB by phosphine;
• The status of gas-tightness of the major facilities in Poland (11 plants, 5,000 - 38,650 m³ each) (there are problems with achieving ideal gassing in 50% or more of all storage facilities, despite additional and costly sealing of the structure);
• Detection, monitoring and management of phosphine resistant strains of the most common pest species;
• Biological and operational factors contributing to the rate of phosphine resistance development;
• Resistance level in the field population of the grain weevil, the rice weevil, the confused flour beetle, and the lesser grain borer (pesticide resistance is found to be more common in the grain weevil than in the lesser grain borer population, while there is no known resistant strain in the confused flour beetle field population);

• Alternative control measures to control phosphine resistant populations of the grain weevil (including carbonyl sulphide in vacuum fumigation chambers; IPM: improvement of detection and monitoring techniques by using new attractants and pheromone compounds in different traps, prevention and mechanical barriers, rotation of pesticides).

VI. TRAINING OF INDUSTRY TECHNICAL STAFF (MB treatment operators) IN POLAND

Workshops held comprise the following scope of topics:-

(1) *Training workshop on IPM of stored product pests*: identification, biology, ecology of major species; detection methods of hidden and open infestation of grains; type of attractant and pheromone traps and methodology of their placement in a storage building; non-chemical methods of control - the role of hygiene and prophylaxis, controlled atmosphere, high and low temperature, irradiation, biological control; chemical methods; the concept and practice of IPM of stored product pests,

(2) *Training workshop on stored product pests and their control*; and

(3) *Increasing the involvement of the Polish Association of Disinfection and Pest Control Operators*.

VII. EXTENSION AND TRAINING OF FARMERS IN HARVEST AND POST-HARVEST TECHNOLOGIES REDUCING PEST INFESTATION

Poland has had a severe hindrance in carrying out extension training around the country. Reasons cited included:-

1. Country central budget problems for fiscal year 2001;
2. Further reduction of government budget allocations for agriculture in 2002;
3. Urgent need for a new arrangement concerning agricultural growth at low income for the majority of farmers.

Registered Post Harvest Treatments and Preparates in Hungary

*Ms. Erzsebet Dormanns-Simon and Dr. Csaba Budai, Csongrad County - Plant and Soil Protection Service Hodmezovasarhely, Hungary*

This presenter gave a technical presentation, briefly giving an overview of the nature of MB use in Hungary, before focusing on alternatives in use for storage/post harvest fumigation treatments.

APPLICATION OF MB IN HUNGARY

MB is not registered for use with any food products; such that whilst there is registration for soil disinfection (Metabrom 980 at a rate of 50 g/m²), root vegetables are not allowed to be planted in the MB treated plots. Consumption of MB has fallen, such that in 1993 was 77 tonnes, falling by 1999 to 40 tonnes.
Pre-harvest MB is generally used in greenhouse soil disinfecting, before the planting of cucumbers, paprika, Gerber, carnation, tobacco, etc. This use is responsible for 83% of Hungary’s total consumption. Another use of MB is in quarantine: disinfection of propagation material, imported woody plants to prevent infestation by quarantine pests (rarely needed), containers, and packing materials for horticulture.

Within the area of fumigation of stored products, Hungary has experimented with Metabrom 980 to treat garlic bulb pests, but it proved to be phytotoxic and inhibited germination. Fogging with sulphur compounds is being developed as an alternative treatment of bulbous plants, such as onion, garlic, flower bulbs, because phytophagous mites are becoming a growing concern.

### Insecticides Registered for the Disinfection of empty stores, packing and vehicles

<table>
<thead>
<tr>
<th>Name of preparate</th>
<th>Active ingredient</th>
<th>Rate</th>
<th>Water volume</th>
<th>Mode of application</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Non-gaseous preparates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinetrin 25 EC</td>
<td>permethrin + tetramethrin + PBO</td>
<td>25 ml/m²</td>
<td>101/100m²</td>
<td>In non-shut stores. Contact-effect only</td>
<td>To be filled with grain for only two weeks</td>
</tr>
<tr>
<td>K-Othrin Flow</td>
<td>deltamethrin</td>
<td>50 ml/100m²</td>
<td>5 l/100m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Slightly gaseous preparates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actellic 50 EC</td>
<td>pirimiphos-methyl</td>
<td>1-2 ml/m²</td>
<td>5 l/100m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reldan 50 EC</td>
<td>chlorpyrifos-methyl</td>
<td>0,5-1,0 ml/m²</td>
<td>5 l/100m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfar 50 EC</td>
<td>ethrimfos</td>
<td>1,0-1,5 ml/m²</td>
<td>5 l/100m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reslin 25 SE</td>
<td>permethrin + S-bioallethrin + PBO</td>
<td>5,6 g/1000 m³</td>
<td>Diluted in 1:6 rate</td>
<td>Recommended to fill the air space after a good contact preparate, in well-shut storage</td>
<td>Effective in stores with many hidden, non-cleanable places</td>
</tr>
<tr>
<td><strong>3. Gaseous types of preparates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unifosz 50 EC</td>
<td>dichlorvos</td>
<td>10 g/100 m³</td>
<td>2,5 l/1000 m³</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4. Smoke preparates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coopex (smoke patron)</td>
<td>permethrin</td>
<td>1/62,5 m³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5. Gasifying preparates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phostoxin tablets</td>
<td>aluminum phosphide</td>
<td>0,5-1/m³</td>
<td>Exposure 72 hours</td>
<td>After treatments 24 hours of draught, measuring of gas concentrations</td>
<td></td>
</tr>
<tr>
<td>Phostoxin pellets</td>
<td>aluminum phosphide</td>
<td>2-3/m³</td>
<td>Exposure 72 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telphos bags</td>
<td>aluminum phosphide</td>
<td>1 bag/11m³</td>
<td>Closed stores/metal silos</td>
<td>Concrete silos</td>
<td></td>
</tr>
</tbody>
</table>

Other insecticides recommended for preventive protection of non-infested grain by this speaker included: Actellic 50 EC (Pirimiphos methyl); Reldan 50 EC (Chlorpyrifos methyl); Satisfar 50 EC (Etrimfos) and K-Obiol 25 EC (Deltamethrin + PBO), applicable to cereals, sunflower, wheat, barley, maize and beans.

Insecticides recommended for treatment of infested stored products (namely cereals, sunflower, wheat, barley, maize, bulk grain, tobacco in bales, peas, rape, flax, mustard and beans stored either in bags and containers, or heaps) were: Phostoxin tablets/pellets (Aluminum phosphide), Fumitoxin pellets/tablets (Aluminum phosphide), Delicia bags (Aluminum phosphide), Delisia Gastoxin (Aluminum phosphide), Degesch plates (Magnesium phosphide), Degesch Magtoxin (Magnesium phosphide).

Insecticides recommended for treatment of infested stored products (namely, cereals, maize, sunflower, winter rape, and peas) were: Degesch Magtoxin (Magnesium phosphide) for treating beans in heaps, maize/peas in bags, flour in bags; Telphos tablets (Aluminum phosphate).
She also described some research work that they have completed on varying temperatures, types of products and durations of exposure to various forms of phosphine, along with their experiments with the use of heating & freezing as a form of pest control. These experiments have yielded mixed results, finding in particular that heating and freezing is not a practical method for pest control.

8.1.7. Section V: Working Session 2: Development of Training Strategies for Implementing Alternatives

In the second working session, countries were allowed to go into their individual country groups to identify potential training strategies to promote the use of methyl bromide for post harvest treatments in their countries.

In the Plenary session that followed, groups once again presented their findings, and summaries of their presentations were input directly into the appropriate summary table, which was projected on LCD projector so that all present could confirm that their findings were accurately recorded by the workshop reporters.

Table 2, below, elaborates the responses received from the countries.
<table>
<thead>
<tr>
<th>Country</th>
<th>National Actions Identified in Working Group 1</th>
<th>Organisations involved in activity and how will interact</th>
<th>Short term (&lt; 6 months)</th>
<th>Medium term (1 year)</th>
<th>Long term (2 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>Retrofitting and Reconstruction of existing silos and storage</td>
<td>Ministry of Agriculture and Forests AF private owners</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preparation and Translation of detailed technical manuals and brochures by sectors</td>
<td>Ministry of Environment and Water OEW, NAAS-translation</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subsidizing new technologies for alternatives</td>
<td>MAF – Registration IPP – Test and Trials</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Registration of more alternatives</td>
<td>MAF, NPP – Registration and tests and trials</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduction of alternatives by private owners of mills / silos</td>
<td>IPP to MAF – suggest and advise - private owners to implement</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduction of non-chemical alternatives in mills and stores</td>
<td>MAF – Registration IPP – Testing</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training of trainers and field missions</td>
<td>NAAS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training of Users</td>
<td>NAAS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgia</td>
<td>Regional training of national trainers</td>
<td>Plant protection service, environmental organizations, suitable health organizations, farm leaders</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identification of sufficient alternatives to MB to move forward on a pilot project</td>
<td>Farmers, ministry of environment, ministry of agriculture, NGO’s and Health organizations</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Development of programs for training of stakeholders</td>
<td>Farmers, environmental organizations and agricultural organizations</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preparation of translated detailed technical manuals and brochures by sectors</td>
<td>Environmental and agricultural</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training and field missions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Activities</td>
<td>Responsible Organizations</td>
<td>Other Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hungary</strong></td>
<td>Regional training of national Trainers</td>
<td>Ministry of Agriculture and Regional Development</td>
<td>Share Information, support alternatives, support trainings, funding etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Further development of technologies for alternatives (needs subsidizing)</td>
<td>Ministry of Environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Registration of more alternatives and support of more alternatives</td>
<td>Plant and soil conservation services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Development of procedures for implementing MB alternatives</td>
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<td>Development of stakeholder training programs</td>
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<td></td>
<td>Development of programs for the technical implementation of alternatives.</td>
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<tr>
<td><strong>Lithuania</strong></td>
<td>Preparation and translation of technical manuals</td>
<td>Ministry of Environment and Plant Protection Service, Chamber of Agriculture, and State Seed and Grain Service</td>
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<td></td>
<td>Training and field missions</td>
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<td></td>
<td>Demonstration, research and investment projects to be implemented</td>
<td>Ministry of Environment and Plant Protection Service, Chamber of Agriculture, and State Seed and Grain Service</td>
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<td></td>
<td>Developing programs for training stakeholders (extension service workers, MB users, and other stakeholders)</td>
<td>Ministry of Agriculture</td>
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| Action | Description | Implementing Agencies | Operative
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<td><strong>Registration of more alternatives</strong></td>
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<td>Ministry of Finance, Company owners</td>
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<td></td>
<td>Further development of technologies for alternatives (needs subsidizing)</td>
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<td>Retrofitting and reconstruction of existing facilities and equipment</td>
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<td><strong>Moldova</strong></td>
<td>Implementation of new technologies for MB alternatives in post-harvest treatment.</td>
<td>Ozone Unit, Institute of Biological Plant Protection, Association ‘Cereale’</td>
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<tr>
<td></td>
<td>Training programmes for all relevant stakeholder to implement MB alternatives</td>
<td>Ozone Unit, Ministry of Agriculture, Republican Nation for Plant Protection, Principal State Inspection for Phytosanitary Quarantine, NGOs; distributors, importers and users of alternatives.</td>
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<tr>
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<td>Demonstration Project on using biological means for post harvest treatment as an alternative to MB</td>
<td>Institute of Biological Plant Protection, Association ‘Cereale’, Ozone Unit and other stakeholders.</td>
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<tr>
<td></td>
<td>Investment project for equipment at mills and tobacco warehouses</td>
<td>Ozone Unit, Institute of Biological Plant Protection, Association Tutun TC, grain stores and mills.</td>
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<tr>
<td></td>
<td>Development of public awareness materials: guidelines, handbooks, brochures etc.</td>
<td>Ozone Unit, NGOs and other stakeholders.</td>
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<tr>
<td><strong>Poland</strong></td>
<td>Establishing national working group on MB alternatives for post-harvest treatments</td>
<td>Ozone Layer Protection Unit (OLPU), Registration Committee, Universities, Plant Protection Inspection, Plant Protection Institute, Biotechnology Institute, Institute of Agriculture Mechanization, Industry Agriculture Extension Service (AES)</td>
<td>Preparation of national workshop for stakeholders</td>
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<td></td>
<td>Implementation of the MB alternatives;</td>
<td>Preparation of pilot projects in 3 sites of various technology levels (needs for International donor)</td>
<td>Assistance in improvement of various facilities (need UNIDO support)</td>
</tr>
<tr>
<td></td>
<td>a. Avoidance technologies</td>
<td>Status of training needs on MB alternatives in these 3 groups</td>
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<tr>
<td></td>
<td>b. monitoring techniques</td>
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<td>c. direct control in storage facilities and structures</td>
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<tr>
<td>Training</td>
<td>a. Training for Industry, technologists and operators</td>
<td>As above including Association of Disinfection, Pest Control Operators</td>
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<td></td>
<td>b. Trainers for Farmers</td>
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<td></td>
<td>c. Custom Officers</td>
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<tr>
<td><em>Slovakia</em></td>
<td>Exemption from pollution taxes of releases of phosphine during use of this alternative.</td>
<td>Ministry of Environment and Economics</td>
<td>X</td>
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<tr>
<td></td>
<td>Customs exemption of taxes for importation of phosphine.</td>
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<td></td>
<td>Better coordination between Ministries in the introduction of new alternatives</td>
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If funds are available; Nationwide training program based on participatory approach in technology adoption and training (study tours, sharing experience) Draft of a manual for trainers and farmers. Needs for UNIDO project.
Table 2: Outputs of Working Group 2 -Strategies for Implementing National Actions Identified in Working Group 1.

*Note: this country also felt strongly that at the international level there should be a pressure on the producers of alternatives and technologies to decrease the prices and availability of alternatives, as well as to accelerate the development and registration of alternatives like SO₂F₂. Also at the international level, there should be a coordination of common policy between the various international agreements.

It should be noted that Latvia did not contribute to this part of the working session, as the representatives of this country were from Quarantine Department, and did not feel that they had enough experience to contribute.

9.0 Conclusions and recommendations of the working group sessions

A plenary session was held to present the key conclusions and recommendations developed by each working group. Each working group gave a brief presentation on their findings, which were outlined above.

Each group gave conclusions and recommendations as follows:

1. Alternatives are present but assistance is required for technology transfer and adaptation to the specific conditions and to produce new alternatives as the existing ones are not always suitable to replace MB; assistance in the development of alternatives and links to financial support for imports of MB

2. More time should be given at each meeting to consider appropriate actions when we meet in working groups. This would include longer break out sessions and more round table discussions on “How to get practical information and ideas.”

3. Closer cooperation with Customs Services to prevent illegal imports of MB in countries that this may be an issue.

4. Develop pilot projects in locations where the use of MB is significant. These would be practical “hands on” projects that would be able to produce results in a short time. The projects would be primarily non-chemical such as sanitation or GMP training and new uses for currently registered products.

5. Provide information and train users in the use of alternatives, especially in flourmills. This would include the safe application of phosphine and other new alternative pesticides. Most alternatives require more knowledge than that of the application of methyl bromide. These would be in the form of video, manuals (translated to various languages) and short “train the trainer” training sessions.

6. Promote information sharing through Manuals that are translated through information networks. These could be set up as part of the UNEP umbrella. This would include a possible “on line” resource center to make it easier for people to find out what research and projects are being carried out in other countries.

7. Inter-country cooperation in techniques to reduce or eliminate the need for fumigation. This would be through the sharing of information of the results of “onsite” projects. This will be a challenge due to the information not being easily available to countries to share.

8. Assistance in meeting EC standards for animal feed quality that avoids the use of MB as much as possible.
9. Assistance in providing information to flour mill owners on the minimum standards required for effective \( \text{PH}_3 \) fumigation. This would include safety, timelines, concentrations and corrosion management.

10. Assistance in determining the basis for the pollution costs arising from the use of \( \text{PH}_3 \) and to give recommendations. This recommendation came from Slovakia.
10. **ANNEXES**

10.1. **Annex I - List of participants**

Regional Training Workshop on Methyl Bromide Alternatives for Post Harvest Treatments  
28-30 May, Sofia, Bulgaria

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AGENDA

**Agenda**

Regional Training Workshop on Methyl Bromide Alternatives for Post Harvest Treatments in Central and Eastern Europe

**Organized by:**
UNEP DTIE OzonAction Programme

**In Cooperation with:**
National Agricultural Advisory Service (NAAS)
Ministry of Agriculture and Forestry

**May 28-30, 2002**
Sofia, Bulgaria

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**Day 1:**

**Hall 1**

08:30-09:30   Registration

09:30-10:15   Opening Session

- Welcome Address
  Dr. Margarita Nikolova, Associate Professor, Executive Director of National Agricultural Advisory Service (NAAS) / Dr. Christian Kamenov, Director Science and Education Directorate, Ministry of Agriculture and Forestry, Bulgaria

- Opening Address
  Boyko Boev, Deputy Minister of Agriculture and Forestry

- Main Objectives of the Workshop
  Cecilia Mercado, UNEP DTIE OzonAction Programme Representative

10:15-10:45   Coffee Break (videos on methyl bromide will be shown)

**Session I**  Overview of Methyl Bromide Phase-Out and its use in Central and Eastern European Countries
Facilitator: Dr. Margarita Nikolova

10:45-11:05 Science of Methyl Bromide and review of methyl bromide phase out requirements under the Montreal Protocol
Christine Wellington, UNEP DTIE OzonAction Programme Representative

11:05-11:35 Overview of Methyl Bromide use in the CEIT region
Dr. Christian Kamenov, Bulgaria

11:35-12:10 Overview of global MB alternatives in post-harvest treatments demonstrated/in use, with specific emphasis to those treatments most appropriate for CEITs.
Mr. Robert Taylor, UNEP Methyl Bromide Technical Options Committee, Natural Resources Institute, United Kingdom

12:10-13:00 Discussion on session 1 presentations.

13:00-14:30 Lunch

Session II MB Alternatives for Post-harvest treatments

Facilitator: Ms. Marija Teriosina, Head of Chemicals Division – Ozone Focal Point, Lithuania

14:30-15:00 The use of phosphine as a Methyl Bromide Alternative in Post-Harvest Treatments
Mr. Robert Taylor, UNEP Methyl Bromide Technical Options Committee, Natural Resources Institute, United Kingdom

15:00-15:30 Protecting stored tobacco with phosphine
Mrs. Antigona Vladovska, Director, Bulgartabac – Holding Group, Bulgaria

15:30-15:45 Coffee Break

15:45-16:15 MB alternatives for mills and food processing plants (sampling, IPM, sanitation, heat, contact insecticides, and alternative fumigants).
Mr. Dean Stanbridge, Steritech, Canada

16:15-17:00 Discussions on Session II

18:30-20:00 Reception hosted by UNEP and the Government of Bulgaria at restaurant "Dunav" hotel "Rodina"

Day 2:

09:30-16:00 Field tour to (1) a mill factory using phosphine as a treatment for grain and (2) phosphine treatment for stored tobacco in warehouses
Demonstrations will also be conducted to show how various alternatives work.

Day 3

Hall 1

Facilitator: Dr. Antonio Sabater de Sabates, Montreal Protocol Branch, UNIDO

09:00-09:20 Methyl bromide phase out schedules, legal and Customs harmonisation requirements by the European Community
Mr. Tom Batchelor, European Commission (moved here from Day 1 to facilitate Mr. Batchelor’s participation)
09:20-09:40 Question and Answer period on future EC requirements.

Session III Constraints to the Adoption of Methyl Bromide Alternatives for post-harvest treatments
09:40-10:35 Roundtable discussion on MB uses on post harvest, and existing alternatives per country and constraints in adopting alternatives *(each country will make a 5-minute presentation)*
10:35-11:00 Overview on the use of Economic Incentives to Promote the use of alternatives
Ms. Lidia Assenova, State Expert, Ministry of Environment and Water, Bulgaria

"Struma" Hall
11:00-11:45 Working Session 1: *Specific actions to overcome constraints identified in implementing alternatives*

*A Working Coffee Break will be included within Session 1.*

Session IV Development of Training Strategies for Promoting the Use of alternatives to methyl bromide for post-harvest

*Facilitator: Ms. Jadwiga Makosa, ODS Specialist, Poland*

11:45-12:05 The importance of training and demonstration projects in the implementation of alternatives to MB
Dr. Antonio Sabater de Sabates, Montreal Protocol Branch, UNIDO

12:05-12:25 Legal and technical background for introducing the alternatives to MB in post-harvest applications in Poland.
Mr. Ryszard Purski, Chief Specialist - Department of Environmental Policy - Ministry of Environment / Prof. Zbigniew Dabrowski – Akademy of Agriculture in Warsaw

12:25-12:45 Registered Post Harvest Treatments and Preparate in Hungary
Mrs. Erzsebet Dormanns-Simon & Dr Csaba Budai, Csongrad Country – Plant and Soil Protection Service Hodmezovasarhely, Hungary

12:45-14:00 Lunch

Hall 3

Session V Working Session 2: Developing training strategies for implementing alternatives

*Facilitator:

14:00-14:20 Objectives of the Working Session
Christine Wellington, UNEP DTIE representative

14:20-15:20 Small group discussions to develop training strategies and other activities needed to implement alternatives for methyl bromide in post harvest uses.
*Each group will identify appropriate alternatives for major crops using methyl bromide, as well as training and other activities (including use of incentives) needed to implement alternatives*
on a regional/national level. Each group will also identify agricultural organizations, training institutes and other stakeholders that should be involved in the training activities and follow-up actions to be taken.

15:20-15:40 Coffee Break

Hall 1

15:40-16:30 Plenary Session.
Report from each working group from the 2 working sessions (10 minutes each) summarizing proposals for training strategies and programmes, stakeholders to involve and follow-up actions.

16:30-16:45 Adoption of Conclusions and Recommendations of the Meeting

16:45-17:00 Closing Remarks

19:30 Farewell party

Agenda for Field Trip (Day 2): 29 May, Wednesday

09:30 Departure from Rodina Hotel.

09:45-10:00 Arriving at the mill factory SOFIA MEL PLC, Loulis Group,

10:00-10:10 Welcome Address
Mr. Mihail Loulis, Executive Director of SOFIA MEL PLC.

10:10-10:30 Visit tour in the laboratory of mill factory.

10:30-11:30 Demonstrations: Using phosphine as a treatment for grain.

11:30-11:45 Demonstration: Suitable equipment using various alternatives for grain treatment and empty store-houses.

11:45-12:00 Presentation of UNIPEST CONTROL Ltd.

12:00-12:30 Videos on J-system for grain treatment in silos and ship will be shown.

12:30-14:00 Lunch organized by the National Agricultural Advisory Service at the Royal Cake Restaurant.

14:00-14:30 Arriving at the warehouse for stored tobacco of SOFIA – BT PLC.

14:30-15:00 Demonstration: Fumigation by Degesh-plates of stored tobacco under Philip Morris’s methodology.

15:00-15:30 Arriving in wine cellar of the National Wine Research Control Institute.

15:30-16:00 Wine-tasting.

16:00-17:00 Sofia sightseeing tour.