Methyl Bromide- Environmental Issues Overview and Position of the US Environmental Protection Agency

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Thomas, B. 1996. Methyl Bromide-Environmental Issues Overview and Position of the US Environmental Protection Agency. In: Landis, T D.; South, D. B., tech. coords. National Proceedings, Forest and Conservation Nursery Associations. Gen. Tech. Rep. PNW-GTR-389. Portland, OR: US. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 139-143. Available at: http://www.fcanet.org/proceedings/1996/thomas.pdf

Abstract-Methyl bromide is used extensively on a global basis as a pesticide against nematodes, weeds, insects, fungi, bacteria, and rodents. As a soil fumigant, it is utilized in significant quantities in the production of strawberries, tomatoes, nursery crops, as well as other agriculture commodities. Grain, fresh fruit, forestry products, and other materials are fumigated with Methyl Bromide to control pest infestations during transport and storage. Structures are also treated with this chemical to control wood destroying insects and rodents. However, methyl bromide has been identified as a significant ozone depleting substance, resulting in regulatory actions being taken by the U.S. Environmental Protection Agency and by the United Nations Environment Program (Montreal Protocol). In the United States, production and importation of this material will cease in 2001. Internationally, production will be halted in 2010. It is critical to identify and implement efficacious and viable alternatives in the near-term.

Keywords: pest control, methyl bromide, fumigant, environment, ozone, policy

Methyl bromide is a broad spectrum pesticide used to control pest insects, nematodes, weeds, pathogens, and rodents. Globally, this material is used most frequently to control pests in the soil (75% of total use), but also against pests in grain and other durable commodities (13% of total), to protect fruits, vegetables and other perishable commodities against pest infestations during transport and storage (9%), and to control wood destroying insects and rodents in buildings, aircraft, ships and other structures (3%) (U.S. EPA 1995b).

In terms of world-wide sales, North America constitutes the largest market with 41 % of the total, followed by Europe with 26%, Asia (including Israel and the Mid-East) with 23%, and lastly Africa, South America, and Australia with about 9% of the market. In North America, this pesticide is used mostly for soil fumigation (87%), but also for commodity and quarantine treatments (8%), and structural fumigation (5%) (U.S. EPA 1995b). In the U.S., most methyl bromide is used in the production of tomatoes and strawberries, but is also a common pest control tool in the nursery (USDA 1993).

The vast majority of this chemical is manufactured by three companies: two located in the U.S. state of Arkansas (Great Lakes Chemical and Ethyl/ Albemarle), and one in Israel (Dead Sea Bromine). These companies utilize naturally occurring bromide salts which are either contained in underground brine deposits (as is the case with Arkansas), or highly concentrated above ground sources like the Dead Sea. Ocean water does contain Bromine salts, but at such low concentrations that it is very energy intensive to use as a source in the manufacture of methyl bromide. Methyl bromide is often produced as a by-product of other bromide manufacturing processes.

When used as a soil fumigant, methyl bromide is injected into the soil at a depth of 12 to 24 inches before a crop is planted. This will effectively sterilize the soil, killing the vast majority of soil organisms. Immediately after the methyl bromide is injected, the soil is covered with plastic tarps, which hold the methyl bromide in the soil. The tarps are removed 24 to 72 hours later. About 50 to 90% of the methyl bromide injected in to the soil eventually enters the atmosphere (Yates et al. 1996; UNEP 1995a; Yagi et al. 1993).

When used as a commodity treatment, methyl bromide is injected into a chamber or under a tarp containing the commodities and held for several hours. Commodities which use this material as part of a post-harvest pest control regime include grapes, raisins, cherries, nuts, and imported materials. Some commodities are treated multiple times during both storage and shipment. Commodities may treated with methyl bromide as part of the quarantine requirements of an importing country. About 80 to 100% of the methyl bromide used for commodity treatments eventually enters the atmosphere (UNEP 1995a).

A structural pest control treatment with methyl bromide involves the fumigation of buildings for termites, warehouses and food processing facilities for insects and rodents, aircraft for rodents, and ships (as well as other transportation vehicles) for various pests. Over 90% of the methyl bromide used in these operations eventually reaches the atmosphere (UNEP 1995a).

In addition to being a widely used pesticide, methyl bromide is an efficient ozone depleting substance (ODS) in the stratosphere. The 1994 Science Assessment of Ozone Depletion, a document prepared by nearly 300 of the world's leading atmospheric scientists, lists the ozone depletion potential (a regulatory benchmark) of methyl bromide as 0.6, and reports that "An uncertainty analysis suggests that the ozone depletion potential (ODP) is unlikely to be less than 0.3." The report quite clearly states that "Methyl bromide continues to be viewed as a significant ozone-depleting compound." Additional research is ongoing to address outstanding uncertainties and to define the precise ODP, which may turn out to be slightly higher or lower than 0.6 (WMO 1994).

Methyl bromide reaches the stratosphere through emissions from agricultural pesticide uses, from the burning of biomass and leaded gasoline and from the oceans. Winds and atmospheric mixing carry this pesticide to the stratosphere. Once in the stratosphere, high energy radiation from the sun release a bromide atom by breaking the bond between the bromine and the methyl group. This bromine atom is in a very reactive state, and will destroy molecular ozone (0). The bromine atom will also react with non-reactive molecules in the stratosphere that contain chlorine, liberating the chlorine, which will then destroy additional ozone molecules. Because of this "chain-reaction", the bromine from methyl bromide is over 50 times more effective at destroying ozone than the chlorine from CFCs on a per atom basis (WMO 1994).

The destruction of stratospheric ozone molecules results In a thinning of the ozone layer. Since ozone blocks radiation that is harmful to life, the destruction of this thin layer will result in an increase of radiation reaching the surface of the earth. This ultraviolet radiation is harmful to biological organisms, including crop plants and human beings. The amount of

methyl bromide produced by agricultural and other anthropogenic sources has considerable impact on stratospheric ozone, disrupting the natural balance of the atmosphere and increasing the amount of hazardous UV radiation that reaches the earths surface (WMO 1994).

Because science has linked methyl bromide emissions to ozone destruction, and thereby to the harmful effects of ultraviolet radiation, it is therefore necessary to control the emissions of this material. This is achieved through regulatory actions, and numerous efforts are underway to control use, emissions and production. Regulatory actions can initially be difficult and confounding for those most closely affected, but will usually lead to a better way of doing things. While the economic issues involved are complex, especially for those that use or manufacture methyl bromide, tile long-term risks to human health and the environment far outweigh any short-term monetary benefit. Ozone depletion is a serious matter, with potential impact not only to human health and the environment, but to agricultural crops as well. It is ironic that some of today's farmers may be sacrificing long-term agricultural production by using a short-term economically attractive pest control method.

In the United States, the U.S. Clean Air Act Amendments of 1990 (title VI), requires that any ozone depleting substance with an ozone depletion potential of 0.2 or greater be listed as class I substances and be phased out within seven years. Under this authority, and with due consideration of the science, the U.S. Environmental Protection Agency (EPA) took regulatory action in 1993 to prohibit the production and importation of methyl bromide in the United States after January 1, 2001. In addition, this regulation froze U.S. production in 1994 at 1991 levels (USEPA 1993). The U.S. phaseout applies solely to production and imports and does not restrict the use of methyl bromide before or after 2001.

Part of the U.S. regulatory effort is to insure that farmers have access to new pesticides as soon a possible. To do this, the U.S. Environmental Protection Agency Office of Pesticide Programs has set up an accelerated registration process for alternatives for methyl bromide (USEPA 1995a). This program speeds paperwork and support functions during the registration process. A task force has been set up to track alternative development, and monitor the program for problems.

On an international level, methyl bromide is regulated in a number of countries besides the United States. The Netherlands phased out the use of methyl bromide for soil fumigation in 1992 because of ground water contamination concerns. Denmark and other Nordic countries will ban agricultural use of methyl bromide in 1998, and other European countries may follow a similar schedule. The European Union and Canada will cut agricultural use by 25% in 1998. A number of other countries are now contemplating regulatory action for methyl bromide use and production.

The Montreal Protocol Treaty (signed by more than 150 countries) governs worldwide production and trade of ozone depleting substances (ODS), and is now in the process of a global ODS phase out. In 1992, the Signatories to the Montreal Protocol ("Parties") considered the science on methyl bromide, set an ozone depletion potential (ODP) of 0.7, and froze production in 1995 at 1991 levels. At the 1995 meeting of the Parties to the Montreal

Protocol, a global methyl bromide production phaseout was agreed upon for developed countries which will require a 25% reduction in 2001, a 50% reduction in 2005, and a complete phaseout in 2010. Developing nations agreed to a freeze in 2002 based upon an average of the years 1995-1998 (UNEP 1995b). This agreement will be revisited in 1997. The U.S. position at these meetings was a total global phase-out by 2001.

The Montreal Protocol creates an effective, level playing field for all countries by harmonizing regulations on a global basis. However, in order to achieve global protection from increased radiation and avoid significant trade disparities, it is critical that all countries involved in the production and use of ozone depleting substances move to alternatives as quickly as possible. This is especially consequential with regard to methyl bromide.

There is no one alternative for all of the uses of methyl bromide, but there are numerous chemical and non-chemical pesticides existing today which effectively manage many of the pests for which methyl bromide is used. Viable alternative materials need not be identical to methyl bromide, but must effectively and economically manage those pests which are now being targeted by methyl bromide.

While the pests that infest nursery soil are effectively managed by methyl bromide, more species specific materials and methods can be used. Chemicals, such as 1,3-dichloropropene, chloropicrin, metam sodium, and dazomet can be used to achieve a similar level of pest control as methyl bromide (Carey 1994; Duncan 1991; Noling and Becker 1994). Non-chemical pest management alternatives to methyl bromide for pest suppression include solarization, organic amendments, biological control agents, crop rotation, and other cultural practices (Chellemi et a]. 1993; Gaur and Dhingra 1991; Grossman and Liebman 1994; Kammwischer-Mitchell et al. 1994; Katan 1981; Liebman 1994; Quarles and Grossman 1995; Rodriguez-Kabana and Jones 1987). Research on additional alternatives is underway and will likely result In a wide range of options, depending on pest control needs.

While most of the alternatives may cost more than methyl bromide in the short-term, costs will likely fall. To insure complete development of viable alternatives, however, it is critical that the research momentum now underway within the U.S. Department of Agriculture, academic institutions, and the private sector not be slowed by efforts designed solely to delay the methyl bromide phase out.

In conclusion, it is critical to acknowledge the vast amount of scientific evidence that indicates methyl bromide is a significant ozone depleting material. Because of this, use and emissions must be discontinued as soon as possible. There are number of pest and crop specific materials that are active against the pests now managed by methyl bromide. Most likely chemical alternatives will fill needs in the short-term, while eventually, non-chemical materials and methods will be the management tools of choice. It is essential to the preservation of the global ecosystem that emissions from the use of this material be halted in a rational manner.

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