Review Articles on Alternatives to Fumigant Pesticides

United Nations Environment Program (UNEP) Reviews

United Nations Environment Programme. 2006. Methyl Bromide Technical Options Committee. *2006 Report of the Methyl Bromide Technical Options Committee, 2006 Assessment*. Montreal Protocol on Substances that Deplete the Ozone Layer.
Abstract: The MBTOC addresses the technical feasibility of chemical and non-chemical alternatives for the current uses of MB, apart from its use as a chemical feedstock. The MBTOC 2006 Assessment reports on advances since 2002 in the technical and economic feasibility of alternatives to replace methyl bromide and, in particular, on commercial adoption of alternatives and potential alternative treatments to MB as a soil fumigant and as a fumigant of durable commodities and structures; and approved and potential alternatives for quarantine and pre-shipment treatments, including treatments for perishables. It also shows trends in methyl bromide production and consumption in both Article 5 and non-Article 5 Parties, estimated levels of emissions of MB to the atmosphere, and strategies to reduce those emissions. In addition, the report describes critical uses of MB that have been approved by the Parties for 2005 onwards and on economic issues influencing MB phase-out.
Link: MBTOC2006.pdf

United National Environment Programme, Division of Technology, Industry and Economics, OzonAction Programme. 2000. *Case Studies on Alternatives to Methyl Bromide: Technologies with Low Environmental Impact*. United Nations Publications.
Abstract: Achieving the methyl bromide phase out is one of the last remaining challenges for ozone-layer protection. Since 1997, the search for alternative techniques has been on-going. This publication documents 18 worldwide case studies that illustrate non-chemical alternative techniques successfully used for major crops/commodities. Each case study presents information on the alternative technique; comparison of yields and performance; comparison of costs; acceptability to regulators and consumers; and applicability to other regions and uses. The case studies show that non-chemical alternatives are cost effective and safer for workers, local communities and the environment.
Link: https://unp.un.org/details.aspx?pid=12286

United National Environment Programme. 1999. Division of Technology, Industry and Economics, OzonAction Programme. *Methyl Bromide Phase-Out Strategies: A Global Compilation of Laws and Regulations*. United Nations Publications.
Abstract: This 1999 compilation focuses on policy measures for countries developing action plans and implementing measures to promote the phase out of methyl bromide
Link: http://www.uneptie.org/Ozonaction/information/mmcfiles/3020-e.pdf

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United Nations Environment Programme. 1998. Methyl Bromide Technical Options Committee. *1998 Assessment of Alternatives to Methyl Bromide*. Montreal Protocol on Substances that Deplete the Ozone Layer.
Abstract: The MBTOC addresses the technical feasibility of chemical and non-chemical alternatives for the current uses of MB, apart from its use as a chemical feedstock. The MBTOC 1998 reports on MB usage; the quantities produced and consumed; existing and potential alternative treatments for its uses a soil fumigant; as a fumigant of durable commodities and structures; and as a fumigant of perishable commodities. The report also provides a developing country perspective, covers quarantine and pre-shipment issues and methods for reducing MB emissions.
Link: MBTOC98.pdf

United Nations Environment Programme, Industry and Environment. 1998. OzonAction Programme. *Methyl Bromide: getting ready for the phase out*. Montreal Protocol on Substances that Deplete the Ozone Layer.
Abstract: This brochure was developed by the UNEP IE's OzonAction Programme to assist developing countries under the Multilateral Fund of the Montreal Protocol on Substances that Deplete the Ozone Layer

to raise awareness about methyl bromide's role in ozone depletion and to promote the adoption of effective alternatives.
Link: http://www.unep.fr/ozonaction/information/mmcfiles/2294-e.pdf

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Additional Review Articles

Rosskopf, Erin N., Daniel O. Chellemi, Nancy Kokalis-Burell, and Gregory T. Church,
Alternatives to Methyl Bromide: A Florida Perspective, USDA-ARS, US Horticultural research Laboratory, Fort Pierce, FL 34945. Plant Management Network. 27 October 2005
Abstract: The first use of methyl bromide as a soil fumigant occurred in France in the 1930s (7). Since its discovery and implementation, methyl bromide has been consistently effective for control of nematodes, fungi, insects and weeds and has been used on more than 100 crops worldwide. Methyl bromide's high vapor pressure allows for rapid and thorough distribution through the soil, enhancing its effectiveness as a fumigant. The high vapor pressure also facilitates a relatively short plant-back interval and gives growers a great degree of flexibility. For nearly four decades, methyl bromide has been the fumigant most heavily relied upon for pre-plant soil treatment for the production of vegetables and ornamentals. The world's largest consumer of methyl bromide is the United States, where the majority of use (83%) is for pre-plant soil fumigation (119). Other uses include post-harvest treatment of stored commodities (11%) and structural fumigation (6%). Based on 1997 U.S. consumption records, 36% of pre-plant methyl bromide use took place in Florida crop production systems, with strawberry, pepper and tomato accounting for 9, 23, and 62% of the soil fumigation uses in the state (84). Methyl bromide is considered essential for the production of eggplant, pepper, strawberry, watermelon and tomato in many locations (41,42,124). The nursery industry accounts for nine percent of the U.S. pre-plant consumption of methyl bromide for the production of potted plants, cut flowers, ornamental nursery plants, fruit and tree nursery plants, sod, bulbs, strawberry and vegetable transplants (118). Within the floriculture industry, there are few statistics on methyl bromide use by individual crops, although certain segments such as the field production of chrysanthemum, caladium, and gladiola rely heavily on its use as a soil fumigant (57).
Link: http://www.apsnet.org/online/feature/methylbromide/

Martin, F. G. 2003. **Development of Alternative Strategies for Management of Soilborne Pathogens Currently Controlled with Methyl Bromide.** ***Annu. Rev. Phytopathol.*** **41 (325-350): 325-350. PDF**
Abstract: The current standard treatment for management of soilborne pests in some high-value crop production systems is preplant fumigation with mixtures of methyl bromide and chloropicrin. With the impending phase-out of methyl bromide, the agricultural industries that rely on soil fumigation face the need for development of alternative pest management strategies. To maintain farm productivity, immediate term research has focused on evaluation of alternative fumigants, modification of current crop production practices to accommodate their use, and improvement of application technologies to reduce the environmental effects of fumigant applications. Longer-term research goals have focused on developing a more integrated approach for pest management that incorporates the use of cultural practices to reduce pathogen pressure, host resistance to disease, and biological approaches for stimulating plant growth and control of root diseases.
Link: http://arjournals.annualreviews.org/doi/abs/10.1146/annurev.phyto.41.052002.095514

Schneider, S. M., Rosskopf, E. N., Leesch, J. G., Chellemi, D. O., Bull, C. T., and Mazzola, M. 2003.
United States Department of Agriculture-Agricultural Research Service research on alternatives to methyl bromide: Pre-plant and post-harvest. ***Pest Management Science*** **59 (6-7):814-826. PDF**
Abstract: Methyl bromide is a widely used fumigant for both pre-plant and post-harvest pest and pathogen control. The Montreal Protocol and the US Clean Air Act mandate a phase-out of the import and manufacture of methyl bromide, beginning in 2001 and culminating with a complete ban, except for quarantine and certain pre-shipment uses and exempted critical uses, in January 2005. In 1995, ARS built on its existing programs in soil-borne plant pathology and post-harvest entomology and plant pathology to initiate a national research program to develop alternatives to methyl bromide. The focus has been on strawberry, pepper, tomato, perennial and nursery cropping systems for pre-plant methyl bromide use and fresh and durable commodities for post-harvest use. Recently the program has been expanded to include research on alternatives for the ornamental and cut flower cropping systems. An overview of the national research program is presented. Results from four specific research trials are presented, ranging from

organic to conventional systems. Good progress on short-term alternatives is being made. These will be used as the foundation of integrated management systems which begin with pre-plant management decisions and continue through post-harvest processing. Published in 2003 for SCI by John Wiley & Sons, Ltd.
Link: http://www3.interscience.wiley.com/cgi-bin/abstract/104534536/ABSTRACT

Martin, F. N., and Bull, C. T. 2002. **Biological approaches for control of some root pathogens of strawberry. *Phytopathology* 92:1356-1362.**
Abstract: Soil fumigation with methyl bromide plus chloropicrin is used as a preplant treatment to control a broad range of pathogens in high-value annual crop production systems. In California, fumigation is used on approximately 10,125 ha of strawberry production to control pathogens ranging from *Verticillium dahliae* to root pruning pathogens such as *Pythium*, *Rhizoctonia*, or *Cylindrocarpon* spp. In addition to pathogen control, fumigation also causes an enhanced growth response of the plant and reduces weed pressure. The development of successful, long-term cost effective biocontrol strategies most likely will require the development of an integrated systems approach that incorporates diverse aspects of the crop production system. Although application of single microbial inoculants may provide some level of control for specific production problems, it will be a challenge to provide the broad spectrum of activity needed in production fields.
Link: http://apsjournals.apsnet.org/doi/pdf/10.1094/PHYTO.2002.92.12.1356

Salles, L.A., D.A. Sosa and A. Valeiro**. 2001. Alternatives for the Replacement of Methyl Bromide in Argentina. Global report on validated alternatives to the use of methyl bromide for soil fumigation-summaries.**
Abstract: The cultivation of strawberry, tomato, cut flowers and tobacco was considered. Strawberry is an economically important crop in Argentina. The amount of land devoted to the cultivation of strawberry varies depending on the region. The use of Methyl Bromide (MeBr) allows to protect the crop from the attack of several soil-borne pests. Several experiences have been carried out to validate already tested alternatives and to adapt them to local conditions for the replacement of MeBr. For this purpose, different chemical fumigants were compared. Dazomet and metam sodium were the fumigants compared for the control of soil-borne fungi, nematodes, insects and weeds. Both products came out as viable alternatives of MeBr. In addition, two other methods, soil solarization and steam, were also validated. Steam is a bit difficult to apply and the initial overall costs for its application may prevent its use. Some problems related to its application are not easily overcome under current conditions. Soil solarization, although effective under certain conditions, cannot be applied everywhere. The area of La Plata is suitable for the production of strawberry, especially for fresh consumption and in that area all these control technologies can be well applied in strawberry fields. Tomato is also an important horticultural crop in Argentina. Also in this case dazomet and metam sodium were effectively used as soil fumigants. Cropping practices of tomato vary in Argentina, depending on the geographical area, and this may determine the choice of the fumigant, besides the economical feasibility of the treatment. Carnation and lisianthus, as cut flowers, are the most important ornamentals in Argentina, being cultivated especially in the green belt of great Buenos Aires. The areas occupied by these crops increase every year. Dazomet and metam sodium showed the same effectiveness as MeBr, as mentioned above for strawberry and tomatoes. These fumigants are potential alternatives to replace MeBr, that is currently used. For tobacco, which is another economically important crop in Argentina, the alternatives for the replacement of MeBr were evaluated in two agricultural systems: (a) the conventional system using chemical fumigants, as metam sodium and dazomet, and (b) the soilless system using floating trays and supported trays. The results of this validation showed that both methods may satisfactorily replace the use of MeBr as soil fumigant for the control of soil-borne pests in tobacco seedbeds. The soilless system has also the advantage that it provides uniform and vigorous crop seedlings and requires a smaller area for the production of tobacco seedlings. Considering the results obtained, it is concluded that the replacement of MeBr in strawberry, tomatoes, tobacco and ornamentals is perfectly possible and feasible, either using a chemical alternative for seedbed desinfection, or soilless systems in trays. The choice of any of these methods should necessarily take into account aspects related to cultivation techniques in that specific zone of the country, economical feasibility and environmental safety.
Link: http://www.fao.org/docrep/004/Y1809E/y1809e00.htm

Friends of the Earth, Farmworker Association of Florida, Farmworker Self-Help, Inc., Florida Consumer Action Network, and Legal Environmental Assistance Foundation. August 1998.
Reaping Havoc: The True cost of using Methyl Bromide on Florida's Tomatoes.
Abstract: Tomatoes are a staple of our lives and the nation's third-largest vegetable crop. It's hard to imagine life without them. Yet most of the tomatoes in the United States are grown with the use of a toxic pesticide, methyl bromide, that poses major health hazards and depletes the ozone layer.

Classified by the U.S. Environmental Protection Agency (EPA) as a "Category I Acute Toxin," methyl bromide is one of the most deadly pesticides used in agriculture. In the United States, where 46.5 million pounds of methyl bromide are used annually, more of this toxic pesticide is applied than in any other country. Florida, where over a third of fresh market tomatoes in the United States are grown , uses a staggering amount of methyl bromide: an estimated 13.3 million pounds in 1996, of which about 5.4 million pounds were used to fumigate tomato-growing fields.

Although methyl bromide leaves little residue on the tomatoes we eat, it kills just about anything that might attack a tomato plant.
Link: http://www.foe.org/camps/comm/atmoshpere/sept99/5.html

Ristaino, J. B., William, T. 1997. Agriculture, Methyl Bromide, and the Ozone Hole: Can We Fill the Gaps? *Plant Disease,* 81(9): 964-977.
This paper reviews the scientific, trade, regulatory, and policy issues that affect the use of methyl bromide in agriculture and discussess available alternatives.
Link:http://www.panna.org/campaigns/docsFumAlts/Ristaino_Thomas_1997.pdf

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Pesticide Action Network North America. May 1995. **Methyl Bromide Alternatives Network (MBAN), San Francisco, CA.**
Abstract:
This is a Methyl Bromide Briefing Kit, which includes alternatives to methyl bromide..
Link: http://www.panna.org/resources/pestis/PESTIS.1996.40.html