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Methyl Bromide: The Problem, the Phase Out, and the Alternatives

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METHYL BROMIDE: THE PROBLEM, THE PHASE OUT, AND THE ALTERNATIVES

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I. INTRODUCTION

Methyl bromide is a very potent pesticide used on over one hundred crops throughout the United States.[1] It is injected into the soil before planting, killing almost everything alive, and securing a pest-free and fruitful harvest.[2] But methyl bromide not only kills nearly everything in the soil, it also destroys the ozone layer.[3]

Methyl bromide was first listed as a Class I ozone-depleting substance after the 1992 Montreal Protocol.[4] A 1998 report issued by the World Meteorological Organization, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, United Nations Environment Program, and the European Commission found that methyl bromide had Ozone Depleting Potential ("ODP") of 0.4.[5] Title VI of the Clean Air Act requires the Environmental Protection Agency ("EPA") to phase out all substances with an ODP greater than 0.2.[6] This latest report only confirms past reports by the same organizations that methyl bromide is contributing to the depletion of the ozone layer.[7]

Methyl bromide is a naturally occurring substance, but significant amounts of it are added to the atmosphere because of human use.[8] As a result, the parties to the 1985 Vienna Conference agreed to substantially lower the risk of Chlorofluorocarbons ("CFC") by means of "international cooperation in research."[9] That agreement is now known as the Montreal Protocol.[10]

When farmers apply methyl bromide to crops, for example, some of the chemical escapes the soil and enters the atmosphere.[11] Once the methyl bromide is in the atmosphere, it eventually reaches the stratosphere where it depletes the ozone

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1. *See* Sondra Goldschein, Note, *Methyl Bromide: The Disparity Between the Pesticide's Phase-Out Dates Under the Clean Air Act and the Montreal Protocol on Substances That Deplete the Ozone Layer*, 4 ENVTL. LAW. 577, 577 (1998).
2. *See* Jeff Wheelwright, *The Berry and the Poison*, SMITHSONIAN MAG., Dec. 1996, at 42.
3. *See id.*
4. *See* Goldschein, *supra* note 1, at 586-89.
5. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).
6. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).
7. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).
8. *See generally* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001) (natural sources of methyl bromide can be found in the ocean, plants, and soil).
9. Anna E. Pribitkin, Comment, *The Need for a Revision of Ozone Standards: Why Has the EPA Failed to Respond?*, 13 TEMP. ENVTL. L. & TECH. J. 103, 106 (1994).
10. *See id.* The Protocol has been signed by over 160 nations and has met several times since the initial convention. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).
11. *See* Kenneth W. Vick, *Quest for Methyl Bromide Alternatives Continues*, AGRIC. RESEARCH, Jan. 1, 2001, at 2, *available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf.

layer.[12] Consequently, the Protocol is phasing out methyl bromide at an international level.[13] The phase out has spurred considerable controversy, especially within the agricultural community and among environmentalists.[14] The two years after the fifty percent reduction, beginning in January 2001, will be the most pivotal in determining how farmers will cope with the loss.[15]

There are several problems stemming from the methyl bromide phase out. First, no alternative has been successfully tested as a perfect replacement for methyl bromide,[16] at least not to the point that farmers would be willing to replace methyl bromide with it. If no comparable alternative is discovered by the time methyl bromide is completely phased out, farmers could incur increased labor costs (most existing promising alternatives are more expensive and require increased labor) and a loss in production.[17] It is important to note, however, that many viable and adequate alternatives do exist.[18] The problem is convincing farmers to use them. Second, non-industrialized nations are subject to a separate set of phase out dates than are industrialized nations, such as the United States.[19] If non-industrialized nations, such as Mexico, are allowed to use methyl bromide while the United States is not, a major shift in the global agriculture market could occur.[20] As a result, industrialized nations may be at a greater disadvantage in the international market.

This Note discusses the ramifications of the methyl bromide phase out in the United States, the current proposed alternatives to methyl bromide, and whether the phase out should continue as scheduled despite the lack of an exact replacement. Part II examines methyl bromide and why it is being phased out. Part III discusses the Clean Air Act and how the phase out schedule is promulgated. Part IV reveals farmers' concerns about the phase out and what they fear will be the consequences.[21] Part V summarizes the leading alternatives to methyl bromide and discusses why finding an adequate alternative has been so difficult, and part VI concludes this Note by summarizing the current situation.

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12. *See id. available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf.

13. *See* Goldschein, *supra* note 1, at 578.

14. *See id.* at 609.

15. *See* Melinda Fulmer, *Strawberry Fields May Not Be Forever Agriculture: Phaseout of Key Fumigant for Orange County's Second-Largest Crop Has State's Growers Seeing Big Trouble Ahead*, L.A. TIMES, Jan. 11, 2001, at C1; *see also* Goldschein, *supra* note 1, at 609.

16. *See* Robert Rodriguez, *California Farmers, Scientists Seek Alternatives to Restricted Fumigant*, FRESNO BEE, Jan. 28, 2001, at C1.

17. *See MB Phaseout Has Farmers Worried*, OZONE DEPLETION NETWORK ONLINE TODAY, Aug. 14, 2000, *available at* 2000 WL 10445790.

18. *See* Goldschein, *supra* note 1, at 592-98.

19. *See id.* at 590-91; *see also* Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 26 I.L.M. 1541, 1555 (1987) (stating non-industrialized nations are nations whose annual calculated level of consumption of methyl bromide is less than 0.3 kilograms per capita).

20. *See* Goldschein, *supra* note 1, at 600-01.

21. This Note focuses on California and Florida farmers because those two states are the primary methyl bromide users in the United States.

II. METHYL BROMIDE: THE CHEMICAL

A. *Ozone Depletion*

Methyl bromide is a popular substance because of its versatility.[22] Not only is it a very effective soil fumigator, it is also used for commodity and quarantine treatment, as well as structural fumigation.[23] One reason methyl bromide is the preferred treatment for so many crops is because it leaves practically no residue in the soil, thereby posing very little health risk associated with the digestion of methyl bromide-treated products.[24] Anyone who has enjoyed a ripe tomato or some juicy strawberries has tasted the fruits of methyl bromide's labor. Despite its many uses, soil fumigation is the primary use for methyl bromide and accounts for eighty percent of its use in the United States.[25] This is because many scientists and farmers consider methyl bromide the most effective soil treatment currently available, as well as being the longest lasting.[26] When farmers apply methyl bromide to their crops, they usually place plastic tarpaulins over the fields after treatment.[27] Unfortunately, enough methyl bromide still escapes into the stratosphere to cause severe damage. Therefore, despite its excellent fumigation capabilities, methyl bromide is being phased out because of the high risk to the environment due to its ozone-depleting capabilities.[28]

B. *DDT and Methyl Bromide*

Methyl bromide's history is similar to that of dichlorodiphenyltrichloroethane ("DDT").[29] DDT was introduced in the United States in 1938, and was in widespread

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22. *See* Goldschein, *supra* note 1, at 592.

23. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001). Soil fumigation is a sterilization process to eliminate all organisms. *See id.* Commodity and quarantine treatment is a process by which the storage facilities of commodities, such as grapes and cherries, are sprayed with methyl bromide to sterilize the commodities. *See id.* Structural fumigation is a process by which buildings, warehouses, and other facilities are fumigated with methyl bromide to eliminate pests. *See* Goldschein, *supra* note 1, at 579-80.

24. *See* Wheelwright, *supra* note 2.

25. *See MB Phaseout Has Farmers Worried*, *supra* note 17, *available at* 2000 WL 10445790.

26. *See* Frank Urguhart, *1.6 Million Pounds for Research into "Green" Farming*, SCOTSMAN, June 27, 2000, at 26.

27. *See* Vick, *supra* note 11.

28. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

29. *See generally* Elizabeth B. Baldwin, Note, *Reclaiming Our Future: International Efforts to Eliminate the Threat of Persistent Organic Pollutants*, 20 HASTINGS INT'L & COMP. L. REV. 855 (1997) (discussing the history of persistent organic pollutants ("POPs") including DDT).

use by 1947.[30] It was hailed as a miracle because of its ability to destroy insect-borne disease while "'winning the farmers' war against crop destroyers overnight."[31] Similarly, methyl bromide is hailed as a miracle product because of its high success rate and its low price.[32]

However, with Rachel Carson's book *Silent Spring*, published in 1962, concern over the harmful effects of DDT on humans and the ecosystem erupted.[33] Proponents of DDT argued that DDT had a good human health record, similar to the argument being made today by farmers using methyl bromide.[34] The proponents also contended that alternatives to DDT were more harmful to human health and were more expensive, an argument similar to that made by methyl bromide supporters.[35]

After some prior legislation on the use of DDT, the EPA Administrator announced the final cancellation of all remaining crop uses of DDT, effective December 31, 1972.[36] Public health and quarantine uses, however, were exempt.[37] The EPA delayed the effective date of the ban six months to provide DDT users with enough transition time to obtain alternative pesticides.[38] Despite several appeals, the United States' Court of Appeals for the District of Columbia ruled there was substantial evidence to support the EPA's decision to ban DDT, applying the evidentiary standard established by the Federal Insecticide, Fungicide and Rodenticide Act ("FIFRA").[39]

The Federal Environmental Pesticides Control Act ("FEPCA"), a 1972 amendment to the FIFRA, provided the EPA with even more power to regulate the remaining uses of DDT.[40] After finding that the benefits of DDT outweighed the risks, the EPA, in light of the fact that no viable alternative was available, allowed the temporary use to continue.[41] However, based on the history of DDT's regulation and

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30. *See id.* at 861, n.32.

31. RACHEL CARSON, SILENT SPRING 20 (1962).

32. *See generally* Goldschein, *supra* note 1 (discussing methyl bromide's uses).

33. *See* U.S. Envtl. Protection Agency, *DDT: A Review of Scientific and Economic Aspects of the Decision to Ban Its Use As A Pesticide* 251-52 (1975) [hereinafter *DDT: A Review*].

34. *See id.* at 252.

35. *See id.*

36. *See id.* at 255.

37. *See id.*

38. *See id.*

39. *See generally* Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S.C. § 136d(d) (1994) (establishing public hearings and scientific review standards); *see* Envtl. Def. Fund, Inc. v. EPA, 489 F.2d 1247, 1251-54 (D.C. Cir. 1973).

40. *See DDT: A Review, supra* note 33, at 255 (stating the FEPCA allowed the EPA to require that all products containing DDT be registered with the EPA by June 10, 1973. It also authorized the EPA to deny requests for temporary uses of DDT made by the states. However, in certain cases, the EPA used this authority to grant a temporary use permit when an economic emergency existed. EPA also can allow the use of a cancelled pesticide under recent amendments to FIFRA that allow the EPA to exempt any Federal or State agency from FIFRA if an emergency exists).

41. *See id.* at 256. The EPA allowed temporary use of DDT by Federal and State agencies only in the event of an economic emergency. *See id.* All requests were considered on a case-by-case basis. *See id.*

eventual ban, it seems unlikely that private farmers will have any luck obtaining use permits for methyl bromide after the phase out is complete.

C. *Toxicity*

Although the major difference between DDT and methyl bromide is DDT's toxic effect on humans, methyl bromide is not immune from other toxicity problems.[42] In fact, methyl bromide's toxicity is another reason why farmers find themselves so concerned about its use.

Methyl bromide is a Category I acute toxin, the most severe toxin categorized by the EPA.[43] Direct contact with methyl bromide can cause skin and eye irritations, kidney and lung problems, and even central nervous system damage.[44] Methyl bromide does not pose a substantial health risk for consumers of products treated with the pesticide, however. Toxicity is primarily an issue for farm workers and people working or playing near fields treated with methyl bromide.[45]

Because of methyl bromide's toxicity, the California Department of Pesticide Regulation ("DPR") has proposed that employers maintain "use" records for all employees performing certain jobs involving methyl bromide until the phase out is complete.[46] According to the California DPR's records, which extend back to 1982, no deaths have resulted in California from the soil fumigation process.[47] The records do show that of the nineteen deaths in California attributed to methyl bromide exposure, seventeen of them were caused by people illegally breaking into buildings that had been fumigated with methyl bromide.[48] The other two deaths were also related to building fumigation.[49] The Political Ecology Group's, *Push Back the Poison: Ban Methyl Bromide*, website claims that hundreds of Californians are acutely poisoned annually from exposure to methyl bromide, including migrant farm workers and children attending schools adjacent to methyl bromide-treated fields.[50] The Environmental Working Group of Washington, D.C. ("EWG"), however, claims that it cannot

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42. *See* Goldschein, *supra* note 1, at 583.

43. *See* Susan Bruninga, *Ozone Depletion: Phaseout of Methyl Bromide Threatens Farm Economy, House Subcommittee Told*, Chem. Reg. Daily (BNA), (July 14, 2000), at D8. Class I substances are those that are listed under § 7671a(a) of the CAA, and Class II substances are those listed under § 7671a(b) of the CAA. *See id.* Class I substances have a higher ozone depleting potential ("ODP") than Class II substances. *See* Clean Air Act §§ 601(3), 601(4), 42 U.S.C. § 7671 (1999).

44. *See* Bruninga, *supra* note 43.

45. *See* Richard Hall, *Methyl Bromide Regulations Criticized*, AG ALERT: WKLY. NEWSPAPER FOR CAL. AGRIC. (Mar. 15, 2000), *available at* http://www.cfbf.com/aa-0315b.htm (copy on file with author).

46. *See id.*

47. *See id.*

48. *See id.*

49. *See id.*

50. *See* Joshua Karliner et al., *Lethal Injection TriCal Inc. and the Poisonous Politics of Methyl Bromide, available at* http://www.igc.org/peg/poison/trical.htm (last visited Nov. 6, 2000).

prove that any school children were ever made ill because of exposure to methyl bromide-treated fields.[51] A lack of data, however, is no reason to throw caution to the wind when dealing with a chemical. For example, Zev Ross, a pesticide analyst for the EWG argues that methyl bromide "has the potential to drift. Methyl bromide should have been banned years ago."[52] Anne Schonfield, of the Pesticide Action Network ("PAN"), argues that the DPR should be "more serious" about its protection of farm workers and residents, including school children.[53] PAN recommends increasing the buffer zones, decreasing maximum worker exposure times, tightening limits on the use of methyl bromide around schools, and requiring more explicit public records regarding fumigation.[54]

III. CLEAN AIR ACT

A. The Montreal Protocol and the CAA Phase Out Schedule

Despite the controversy about methyl bromide's toxicity, the fact is that it is a Class I Ozone Depletor and it will be virtually unavailable by 2005.[55] Methyl bromide accounts for approximately four percent of the ozone layer depletion.[56] Agricultural fumigation accounts for about half of that four percent.[57] The EPA is concerned that if methyl bromide is not phased out, it could contribute five to fifteen percent of future ozone depletion.[58] The 1997 Ninth Meeting of the Parties to the Montreal Protocol first established the methyl bromide reductions for industrialized countries, which now are as follows: twenty-five percent reduction in 1999, fifty percent in 2001, seventy percent in 2003, and one-hundred percent in 2005.[59] The reduction levels were

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51. *See* Hall, *supra* note 45 *available at* http://www.cfbf.com/aa-0315b.htm (copy on file with author).

52. *Id. available at* http://www.cfbf.com/aa-0315b.htm (copy on file with author). Ross' concern over drifting has not been substantiated by any deaths, but it is a valid concern. *See id.* The fact is that the California Department of Pesticide Regulation proposed placing buffer zones around areas treated with methyl bromide. *See id.* If possible injuries and deaths are enough to force the CDPR to take action, it is quite reasonable for Ross to be worried about the health of children and farm hands. *See id.*

53. *See California: Methyl Bromide Data Lacking, NAS Says; State Still Working to Finalize Regulations*, Chem. Reg. Daily (BNA), (May 9, 2000), at D13.

54. *See id.*

55. *See* Goldschein, *supra* note 1, at 585-90. Title VI of the CAA requires the EPA to phase out ozone-depleting substances with an ODP of 0.2 or higher. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001). One of the most recent studies places methyl bromide's ODP at 0.4. *See id.*

56. *See* Fulmer, *supra* note 15.

57. *See id.*

58. *See id.*

59. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

based on 1991 consumption levels.[60] The reduction levels for non-industrialized nations are follows: twenty percent in 2005 and one-hundred percent in 2015, based on the 1995-1998 average consumption levels which will be frozen in 2002.[61]

In the United States, the EPA is authorized by Congress to promulgate rules regarding the phase out, production, and consumption (but not the use) of ozone-depleting substances.[62] According to section 601a(d) of the Clean Air Act, any Class I substance's phase out must culminate within seven years after January 1 of the year after that substance was added to the Class I list.[63] Because the EPA proposed methyl bromide for addition to the Class I list in 1993, the final rule scheduled the complete elimination of methyl bromide production and importation by January 1, 2001.[64] The EPA's original schedule did not, however, include any interim reductions like those included in the Montreal Protocol.[65] As a result, Congress later directed the EPA to promulgate rules that are identical to those of the Montreal Protocol.[66] This is significant because the Montreal Protocol's phase out schedule is less stringent than the EPA's original phase out schedule that included a complete phase out deadline by 2001.[67]

B. *Differences Between the Montreal Protocol and the CAA*

Some methyl bromide supporters, primarily farmers, contend that the United States should not follow the dates established by the Montreal Protocol because no adequate alternative has yet been found.[68] Despite heavy pressure from farm leaders to alter the phase out schedule again, the EPA has confirmed that it has no intention of doing so.[69] Because the Montreal Protocol is an international treaty, the United States is bound by its terms.[70] However, The Montreal Protocol is not a legally binding document.[71] In fact, parties to the Treaty may withdraw after four years.[72] However,

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60. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

61. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

62. *See* Goldschein, *supra* note 1, at 585; *see also* Clean Air Act §§ 604(c), 605(c), 42 U.S.C. §§ 7671c, 7671d (1999).

63. *See* Clean Air Act § 602(d), 42 U.S.C. § 7671a(d) (1999).

64. *See* Goldschein, *supra* note 1, at 586-87.

65. *See id.*

66. *See EPA Amends NESHAP for Magnetic Tape Manufacturing*, 10 GA. ENVTL. L. LETTER 16, 16 (1999).

67. *See* Goldschein, *supra* note 1, at 599-601.

68. *See* Jerry Hagstrom, *Farm Groups Seek Hill Intervention On Pesticide*, CONGRESS DAILY/A.M., July 14, 2000, *available at* 2000 WL 24187095.

69. *See id. available at* 2000 WL 24187095.

70. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

71. *See* Pribitkin, *supra* note 9, at 107.

72. *See* Montreal Protocol on Substances That Deplete the Ozone Layer, *supra* note 19, at

section 614(b) of the Clean Air Act demonstrates the United States' intentions of enforcing the Protocol:

> This subchapter as added by the Clean Air Act Amendments of 1990 shall be construed, interpreted, and applied as a supplement to the terms and conditions of the Montreal Protocol . . . and shall not be construed, interpreted, or applied to abrogate the responsibilities or obligations of the United States to implement fully the provisions of the Montreal Protocol.[73]

Although the CAA's original 2001 complete phase out deadline was more stringent than the phase-out proposed by the Montreal Protocol, the 2005 complete phase-out date most likely will stand. It is unlikely that the 2005 phase-out date will change, despite at least two proposed amendments to the CAA.[74] The EPA has already extended the complete phase out date once it is unlikely for it to do so again.

C. GATT's Role in the Phase Out

Because the Montreal Protocol involves ozone-depleting chemicals that are manufactured and distributed throughout the world, it is possible for it to conflict with other international laws and treaties.[75] One potential problem with the Montreal Protocol is its effect on the General Agreement on Tariffs and Trade ("GATT").[76] GATT is an international trade system that constantly changes with as the global market does.[77] Two goals of GATT are to reduce trade barriers and eliminate discriminatory treatment in international commerce.[78] However, the Montreal Protocol's Multilateral Fund, which provides funds to developing nations to aid in their compliance of the Protocol, could violate the GATT's provision against subsidies.[79] The original portion of GATT that dealt with subsidies is Article XVI, section A.[80] In 1955, section B was added to GATT, but does not apply to developing nations.[81] Because one section only applies to developed countries, and the parties to GATT felt that further definition of subsidies needed to be made, the Subsidies Code was developed at the 1979 Tokyo

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73. Clean Air Act § 614(b), 42 U.S.C. § 7671m (1999).

74. One such proposal seeks to level the field between the United States and developing nations by eliminating the delayed phase out for developing nations. *See* 141 CONG. REC. H8534-35 (daily ed. Aug. 4, 1995).

75. *See* Scott N. Carlson, *The Montreal Protocol's Environmental Subsidies and GATT: A Needed Reconciliation*, 29 TEX. INT'L L.J. 211, 212-13 (1994).

76. *See id.* at 213.

77. *See id.*

78. *See* General Agreement on Tariffs and Trade, Oct. 30, 1947, 61 Stat. A3, 55 U.N.T.S. 194.

79. *See* Carlson, *supra* note 75, at 218-19.

80. *See id.* at 216.

81. *See id.*

Round.[82] The Subsidies Code only applies to non-primary products,[83] which would include farm products. However, developing countries have not yet acted accordingly to the rule.[84]

Developing countries do not seem to want to be held to limitations on subsidies.[85] Subsidies are a very important tool for developing countries to receive financial assistance, enabling them to comport with international laws and treaties. Thus, subsidies are not just a means to give developing countries financial aid. Not only does the Multilateral Fund allow developing countries to better comply with the Montreal Protocol, it also encourages development.[86] If developing countries know they will have the financial aid they need to comply, then they will be more likely to develop ozone-safe technology and help fix a problem that affects the entire world. In fact, most developing nations probably would not have even joined the Montreal Protocol had it not been for the Multilateral Fund.[87] Global cooperation is absolutely imperative to fix the ozone problem. Offering developing countries a means to cooperate is a good start.

The relevant language of GATT states that any subsidies that "operate directly or indirectly to increase exports of any product from, or to reduce imports of any product into, its territory . . . ." could be interpreted to mean that the Multilateral Fund does indeed violate this provision.[88] However, because of how the developed countries have handled the issue of subsidies, it is unlikely that the Montreal Protocol's Multilateral Fund will violate GATT.[89]

It is important to realize that the Protocol does not exist in a vacuum. GATT is not the only international law that has affected the Protocol, or vice versa. It is merely one example of how complex international law can be affected by one chemical that depletes the ozone. The methyl bromide phase out affects not only farmers and consumers, but international trade law as well.

IV. FARMERS' CONCERNS

A. *California and Florida*

The phase out is of particular concern to farmers in California and Florida, the leading users of methyl bromide in the United States.[90] Methyl bromide is especially

82. *See id.* at 217.
83. *See id.*
84. *See id.* at 218.
85. *See id.* at 229-30.
86. *See id.* at 227.
87. *See id.* at 228.
88. *Id.*
89. *See id.* at 220.
90. *See* Goldschein, *supra* note 1, at 578, 605.

beneficial to strawberry and tomato farmers.[91] In fact, before California farmers used methyl bromide as a soil fumigant, the average strawberry acre yielded one to five tons.[92] Largely due to fumigating with methyl bromide, average yields have ranged from twenty to twenty-five tons.[93] California uses up to 6.7 tons of methyl bromide annually to treat grapes, almonds, and of course strawberries.[94] In Orange County, California, strawberry fields accounted for 1,970 acres and generated $80 million in 1999, according to the Orange County agricultural commissioner's office.[95] In Florida, farmers treat ninety-nine percent of their strawberry crops with methyl bromide,[96] and according to one Florida strawberry farmer, most Florida farmers have never used anything other than methyl bromide for crop treatment.[97] Colin Carter, a UC Davis economics professor who has studied the ramifications of the phase out, claims that as the full impact of the ban is felt during the next few years, "it will mean lost acreage and fewer jobs for the berry industry's 25,000 workers."[98] If no adequate alternative is found, then more fields will succumb to pests and soil diseases, a loss expected to cause California's strawberry revenue to decline seventeen to twenty-eight percent.[99]

Another of Florida's concerns about the methyl bromide phase out is its $400 million tomato crop.[100] It produces forty-five percent of the tomatoes consumed in the United States.[101] However, Mexico exports more tomatoes to the United States than Florida alone produces.[102] Under the Montreal Protocol, Mexico is subject to the non-industrialized phase out schedule, and Florida farmers are concerned that Mexico's methyl bromide usage advantage, coupled with a disastrous 1999 tomato crop for the United States, could destroy Florida's $400 million business.[103] Florida Farm Bureau Federation President Carl Loop stated, "[t]he loss of methyl bromide will mean more acres for Mexico and no net environmental gain since Mexico will produce tomatoes on land fumigated with methyl bromide."[104] The disparities in the phase out schedules affect mostly the individual farmers. Cecil Martinez, a strawberry grower on eighty-eight acres in Oxnard, California, states, "[i]t's frustrating because these [other] coun-

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91. *See* Wheelwright, *supra* note 2.
92. *See id.*
93. *See id.*
94. *See id.*
95. *See* Fulmer, *supra* note 15.
96. *See Alternatives to Methyl Bromide Needed Before Phaseout, Say Experts,* PESTICIDE & TOXIC CHEM. NEWS, July 20, 2000, *available at* 2000 WL 12049473. *See also* Fulmer, *supra* note 15.
97. *See MB Phaseout Has Farmers Worried, supra* note 17. *See* Fulmer, *supra* note 15.
98. Fulmer, *supra* note 15.
99. *See id.*
100. *See* Andrew Meadows, *Florida Tomato Growers Fear Increasing Imports From Canadian Rivals*, TAMPA TRIBUNE, Oct. 4, 2000, at 1.
101. *See Alternatives to Methyl Bromide Needed Before Phaseout, Say Experts, supra* note 96, *available at* 2000 WL 12049473.
102. *See* id.
103. *See id.*; *see* Meadows, *supra* note 100.
104. *See Alternatives to Methyl Bromide Needed Before Phaseout, Say Experts, supra* note 96, *available at* 2000 WL 12049473.

tries are becoming big producers really fast. How can I compete with my competitor to the south who pays [workers] $4 an hour and doesn't have to adhere to the same rules and regulations?"[105] Non-industrialized nations, known as "Article 5" countries because Article 5 of the Montreal Protocol establishes the ten-year grace period, also are entitled to receive technical and financial assistance from the industrialized nations during the phase out, as discussed in Section II.B of this Note.[106]

To compound the problem, Canada, which is subject to the same phase out schedule as the United States, exports hydroponic tomatoes—tomatoes grown without soil and without such pesticides as methyl bromide.[107] Canada's total export of tomatoes to the United States in 1999 was $121 million, a 660% increase from 1994.[108] Hydroponics is one of the alternatives for methyl bromide discussed infra.

B. *Imports and Exports*

Another concern for American farmers is the fact that several nations, such as Japan, require certain United States agricultural products to be treated with methyl bromide as an importation condition, because methyl bromide treatment reduces the likelihood of receiving infested commodities.[109] Likewise, the United States requires certain products from India and Chile to be treated with methyl bromide before importation.[110] The combined loss of exports and increased cost of imports due to the methyl bromide phase out could cost the United States $1 billion annually.[111]

The EPA, however, contends that although American farmers may face a tougher global market due to the phase out, a total loss is highly unlikely.[112] In fact, since the twenty-five percent cutback in 1999, there have been no serious crop loss or business failures, according to the president of the California Strawberry Commission.[113] Also, developing countries account for only twenty-seven percent of the

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105. Fulmer, *supra* note 15.

106. *See* Timothy T. Jones, *Implementation of the Montreal Protocol: Barriers, Constraints and Opportunities*, 3 ENVTL. LAW. 813, 846-47 (1997).

107. *See* Meadows, *supra* note 100.

108. *See* id.

109. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001); *See also* Goldschein, *supra* note 1, at 605. It is rumored among the industry that China is currently building a methyl bromide factory. *See MB Phaseout Poses Challenge for CA Growers*, OZONE DEPLETION NETWORK ONLINE TODAY, Feb. 6, 2001, *available at* 2001 WL 10223475.

110. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001); *See also* Jefferson D. Reynolds, *International Pesticide Trade: Is There Any Hope for the Effective Regulation of Controlled Substances?*, 13 J. LAND USE & ENVTL. L. 69, 78 (1997).

111. *See* Goldschein, *supra* note 1, at 605.

112. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

113. *See* Fulmer, *supra* note 15.

worldwide use of methyl bromide.[114] Production of methyl bromide occurs primarily through three companies: Albemarle (United States), Great Lakes Chemical (United States), and Dead Sea Bromine (Israel).[115] Because the leading producers of methyl bromide are the United States and Israel, two nations subject to the 2005 complete phase out date, the EPA contends that once the supplies become less and less available, and consequently the price of methyl bromide rises, farmers will have to turn to methyl bromide alternatives, even if some of those alternatives cost more than methyl bromide.[116] The EPA's predictions about price increases appear to be correct. Methyl bromide prices have already doubled from 1995 rates to more than $2 per pound.[117] Many small farmers have no other choice but to stop using methyl bromide and start using less expensive alternatives. Once the alternatives are widely used, the price of those alternatives likely will decrease and a more "level playing field" will exist.[118] In support of the EPA and the phase out, Anne Schonfield of PAN stated, "I think we've seen this several times where [they] say, 'The sky is going to fall if we get rid of this pesticide.' We saw that with DDT. Farmers are very innovative, and, with a lot of assistance, they can get rid of these dangerous pesticides."[119]

Despite the EPA's contentions that the methyl bromide phase out will not be as detrimental to farmers as is feared, farmers are still greatly concerned.[120] One aspect of the Montreal Protocol often overlooked by opponents of the phase out is the critical use exemption.[121] The Montreal Protocol allows for an exemption after the January 1, 2005, phase out, but only for critical uses.[122] Although the protocol does not define "critical," it does provide some factors to consider when determining whether a use is critical.[123] The main factor in determining whether a use is critical is the absence of technically and economically feasible alternatives.[124] Production of methyl bromide for a critical use will only be permitted if certain conditions are met,

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114. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

115. *See* Karliner, *supra* note 50, *available at* http://www.igc.org/peg/poison/trical.htm (last visited Nov. 6, 2000).

116. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

117. *See* Fulmer, *supra* note 15.

118. EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

119. Fulmer, *supra* note 15.

120. *See MB Phaseout Poses Challenge for CA Growers*, *supra* note 109, *available at* 2001 WL 10223475.

121. *See* BRUNINGA, *supra* note 43.

122. *See Methyl Bromide Critical Use Exemption, at* http://www.epa.gov/ozone/mbr/cueqa.html (last updated May 5, 2000).

123. *See Methyl Bromide Critical Use Exemption, at* http://www.epa.gov/ozone/mbr/cueqa.html (last updated May 5, 2000).

124. *See Methyl Bromide Critical Use Exemption, at* http://www.epa.gov/ozone/mbr/cueqa.html (last updated May 5, 2000).

such as minimization of production and lack of existing methyl bromide.[125] Although the 1990 Clean Air Act did not originally allow for a critical-use exemption, the amended section 604(d)(6) gives the EPA Administrator the authority to employ an exemption after complete phase out, but only to the extent it is consistent with the Protocol's critical use exemptions.[126]

Farmers are not completely satisfied with the exemption, because of the amount of time it probably will take to get the exemption rulemaking finalized. And it may take some time before the effects of the critical use exemption can be seen.[127] In the meantime, farmers should be exploring their options and not relying on obtaining a special use exemption.

The Montreal Protocol also has an exemption for quarantine and pre-shipment uses of methyl bromide.[128] The exemption allows for the continued production of methyl bromide for these limited uses.[129] In order for the Protocol exemption to be applied in the United States, the Clean Air Act had to be amended in 1998, allowing the EPA Administrator to create the exemption.[130] Because this exemption only regards quarantine and pre-shipment uses, a small percentage of methyl bromide use, it really does not help the average farmer very much. The Quarantine and Pre-shipment Regulation was recently published in the Federal Register, in accordance with the good cause exemption from the notice-and-comment rulemaking requirement of the Administrative Procedure Act.[131] The exemption does, however, show that the parties to the Protocol and the Administrator are aware that certain uses of methyl bromide need to be allowed in order to not stifle intra and international trade.

V. ALTERNATIVES

A. *Need for Alternatives*

After accepting that the methyl bromide phase out will continue on schedule, the next hurdle for farmers is finding an adequate alternative. Currently, there is no

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125. *See Methyl Bromide Critical Use Exemption, at* http://www.epa.gov/ozone/mbr/cueqa.html (last updated May 5, 2000).

126. *See Methyl Bromide Critical Use Exemption, at* http://www.epa.gov/ozone/mbr/cueqa.html (last updated May 5, 2000); *see also* Omnibus Consolidated and Emergency Supplemental Appropriations Act, Pub. L. No. 105-277, § 764(b), 112 Stat. 2681, 2681-36, 37 (codified as amended at 42 U.S.C. § 7671c (1998)).

127. *See* Fulmer, *supra* note 15.

128. *See Pesticides: Methyl Bromide Rule Pending at OMB Would Delay Complete Phaseout to 2005*, Chem. Reg. Daily (BNA) (Sept. 7, 2000), at D-4.

129. *See id.*

130. *See* § 764(b), 112 Stat. at 2681.

131. *See* Domestic Quarantine Notice, 66 Fed. Reg. 37,576 (July 19, 2001) (to be codified at 7 C.F.R. pt. 301).

perfect replacement for methyl bromide. But adequate chemical and non-chemical alternatives do exist. The next sections examine how undeveloped nations are dealing with the search for alternatives, what type of research is being conducted here in the United States, and what those alternatives are in the United States. Because soil accounts for the majority of methyl bromide use in the United States, the following subsections examine alternatives for fumigation uses.

B. *Search for Alternatives in Undeveloped Nations*

The critical issue with the methyl bromide phase out is the supposed lack of viable alternatives.[132] However, several alternatives to methyl bromide do exist, although their viability is a point of contention among the farming and scientific communities.[133] The lack of alternatives is an even greater problem in undeveloped nations.[134]

Despite their extended phase out deadlines and the economic and technological assistance from the industrialized parties, undeveloped nations are still struggling to find adequate alternatives.[135] Without a substitute for methyl bromide, undeveloped nations will likely face a disastrous loss of crops; a loss that they feel is not justified by compliance with the Montreal Protocol.[136] The main complaint of undeveloped nations is that the developed nations caused the ozone problem.[137] Therefore, those developed nations should be the ones to solve the problem of their own creation.[138] It is an understandable and logical argument. Undeveloped nations' economic and agricultural development should not suffer because they have to help solve a problem they did not create, and they should have an equal amount of funding and technology available to them to the same extent that developed nations have.[139] However, the ozone layer covers the entire world; if it is further depleted, it will negatively affect the entire world.[140] Even though undeveloped nations may not have contributed very much to the depletion of the ozone layer, they are affected by it.[141] And as the developed nations work to fix the problem, they are fixing it for the entire world. In the future, undeveloped nations will benefit from the Montreal Protocol and from what the developed nations are doing to reduce methyl bromide production and use.

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132. *See* Lee Anne Duval, Note, *The Future of the Montreal Protocol: Money and Methyl Bromide*, 18 VA. ENVTL. L.J. 609, 621 (1999).
133. *See id.* at 622-23.
134. *See id.*
135. *See id.* at 623.
136. *See id.* at 622.
137. *See id.*
138. *See* id.
139. *See id.* at 622-23.
140. *See generally id.* (developing countries attempting to respond with alternatives to methyl bromide).
141. *See id.* at 625.

Despite the debate over which alternatives will work the best, if any, the fact is that after 2015, methyl bromide will not be an option for underdeveloped nations. According to Tom Trout, a U.S. Department of Agriculture scientist, "If there was anyone out there with their head stuck in the sand thinking this issue would go away, they better take it out."[142] As a result, it is unlikely that the parties will further extend the phase out schedule for undeveloped or developed nations to the Montreal Protocol.

C. *Government-Funded Research Projects*

Despite the grim forecast that there is no viable alternative, there has been no shortage of research done in this area. Willie Pennington, a representative of BASF, Inc., stated, "[w]e have alternatives to methyl bromide. Everybody's working on an alternative right now."[143] Researchers across the country (and the globe) are working vigorously to test existing alternatives and to create new ones.[144] For example, the University of California's Sustainable Agriculture Research and Education Program ("SAREP") is funding several studies involving methyl bromide.[145] Currently, SAREP is working on seven research products focused on methyl bromide alternatives for strawberries, grapes, and orchard crops.[146]

The Agricultural Research Service ("ARS"), the scientific arm of the USDA, has scientists in twenty of its laboratories across the country striving to find and test methyl bromide alternatives.[147] Their research is focusing on the development of new methods of destroying microbial, weed, and insect pests.[148]

D. *Chemical Alternatives*

1. *Messenger®*

State-funded organizations, however, are not the only ones studying methyl bromide alternatives. One of the most promising alternatives is the product "Messenger®", produced by Eden Biosciences Corporation ("Eden").[149]

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142. Rodriguez, *supra* note 16.

143. Heather Felton, *Florida Farmers Look for Alternatives to Banned Pesticide*, BRADENTON HERALD-FLORIDA, Nov. 10, 2000, at 1, *available at* 2000 WL 28951296.

144. *See Search for Alternatives to Current Agricultural Fumigants Heats Up As EPA Enforces New Guidelines*, Associated Press, Jan. 9, 2001, at 1.

145. *See id.*

146. *See id.*

147. *See* Vick, *supra* note 11, *available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf.

148. *See id., available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf.

149. *See EPA Grants Two-Year Registration to New Biochemical Pesticide*, 28 PESTICIDE & TOXIC CHEMICAL NEWS, 2000, at 6.

Eden received a two-year registration for Messenger in May 2000.[150] Messenger® is the trade name for the protein Harpin, a completely naturally occurring protein that elicits a natural defense mechanism in the host plant, called a systematic acquired resistance.[151] In fact, according to an EPA official, Harpin is the first natural product that initiates the systematic acquired defense mechanism.[152] Harpin is effective because it makes plants resistant to certain pathogens.[153] Because Harpin has no direct killing effect on pests and pathogens, and it is applied at low rates, residue-free produce is a likely positive benefit of this product, as well as the fact that it will not promote resistance in pest populations.[154] Messenger® can be applied topically either by itself or in conjunction with other pesticides.[155]

Messenger® is officially classified as a biochemical pesticide, and according to the EPA Office of Pesticide Programs, it is highly efficient at protecting against a wide spectrum "of fungal, bacterial, and viral diseases, some of which have no other means of control."[156] Messenger® also helps suppress some insect, mite, and nematode pests, as well as enhancing plant growth.[157]

Another benefit is that Messenger® degrades rapidly, leaving no detectable residue, and posing no threat to humans.[158] According to the EPA, Messenger®, classified as a Toxicity Category IV product, "has shown no indication of any toxicity or hypersensitivity" related to the protein after six years of research.[159] Reduction of risk

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150. *See id.* Harpin is produced in an Escherichia coli by transferring a DNA encoding harpin protein from E. amylovora to the cell production strain E. coli K-12. *See id.* At the end of the fermentation process, the E. coli K-12 cells are killed. The Harpin protein and other necessary cell constituents are extracted for formulation into the end product Messenger. *See id. See also Biopesticide Registration Eligibility Document: Harpin Protein, at* http://www.epa.gov/oppbppd1/biopesticides/reds/red_006477.html (last visited Apr. 9, 2002).

151. *See EPA Grants Two-Year Registration, supra* note 149, at 6; *see also EPA Okays Revolutionary Protein-Based Biopesticide,* 257 CHEMICAL MARKET REP. 57, 57 (May 15, 2000), *available at* http://www.Andaricles.com/of_01m0FVP/20_257/62497246/Print.Jhtml (last visited Feb. 7, 2002) (Harpin is "a naturally occurring protein produced by bacteria commonly found in the environment").

152. *See EPA Okays Revolutionary Protein-Based Biopesticide, supra* note 151, *available at* http://www.Andarticles.com/of_0lm0FVP/20_257/62497246/Print.Jhtml.

153. *See EPA Grants Two-Year Registration, supra* note 149, at 6.

154. *See id.*

155. *See* Eden Bioscience, *Frequently Asked Questions, at* http://www.edenbio.com/documents/FAQs.pdf. (last visited Apr. 9, 2002).

156. *Biopesticide Registration Eligibility Document: Harpin Protein, at* http://www.epa.gov/oppbppd1/biopesticides/reds/red_006477.html (last visited Apr. 9, 2002).

157. *See Biopesticide Registration Eligibility Document: Harpin Protein, at* http://www.epa.gov/oppbppd1/biopesticides/reds/red_006477.html (last visited Apr. 9, 2002).

158. *See* Eden Bioscience, *Frequently Asked Questions, at* http://www.edenbio.com/documents/FAQs.pdf. (last visited Apr. 9, 2002).

159. *Biopesticide Registration Eligibility Document: Harpin Protein, at* http://www.epa.gov/oppbppd1/biopesticides/reds/red_006477.html (last visited Apr. 9, 2002)(Toxicity Category IV is the lowest level of toxicity.); *see also* Eden Bioscience, *Frequently Asked Questions, at* http://www.edenbio.com/documents/FAQs.pdf. (last visited Apr. 9, 2002) (discussing the development of Messenger® and its effects).

to field workers applying Messenger® is another strong benefit of the protein.[160] Currently, Messenger® is available in nearly all states, and is continuing to produce excellent results.[161]

2. *Metam Sodium*

Another alternative to methyl bromide is the soil pesticide metam sodium.[162] Metam sodium is a broad-spectrum soil fumigant used to suppress plant nematodes, germinating weed seeds, and pathogenic fungi, all affecting a wide variety of fruit, vegetable, and orchard crops (i.e., apples).[163]

Metam sodium has been used for over forty years in the United States.[164] California, for example, used over fifteen million pounds of metam sodium in 1995 to treat various crops, such as melons, peppers, tomatoes, and strawberries.[165] Despite its many years of use, and despite its benefits of being harmless to the ozone layer, as well as its quality of leaving no residue, metam sodium requires precise application in order to ensure successful suppression of pests.[166] But if applied correctly, it could definitely ease the loss of methyl bromide to farmers.

The EPA concluded in a study that metam sodium's chemical effectiveness in controlling annual and perennial weeds in California's strawberry production was comparable to that of methyl bromide.[167] The EPA also discovered that the economic benefits of metam sodium far outweighed those of methyl bromide, which had long been known for its economic advantage.[168] In that study, metam sodium was applied at 240 pounds per acre, while methyl bromide was applied at 325 pounds per acre.[169] Although the overall yields of crops treated with methyl bromide were fourteen percent greater than those treated with metam sodium, the latter's yields were twenty-six percent greater in the early season.[170] Because the early season's yields received significantly higher prices, and metam sodium treatment cost one third less than the

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160. *See* Eden Bioscience, *Frequently Asked Questions, at* http://www.edenbio.com/documents/FAQs.pdf. (last visited Apr. 9, 2002).

161. *See* Eden Bioscience, *Frequently Asked Questions, at* http://www.edenbio.com/documents/FAQs.pdf. (last visited Apr. 9, 2002).

162. *See* 3 OFF. OF AIR & RADIATION, EPA, *Metam Sodium as an Alternative to Methyl Bromide for Fruit and Vegetable Production and Orchard Replanting, in* ALTERNATIVES TO METHYL BROMIDE: TEN CASE STUDIES: SOIL, COMMODITY, AND STRUCTURAL USE (1997) [hereinafter *Metam Sodium as an Alternative to Methyl Bromide*]. Trade names for metam sodium include: Amvac Metam Sodium®,Busan®, Metam CLR™. *See id.*

163. *See id.*

164. *See id.*

165. *See id.*

166. *See id.*

167. *See id.*

168. *See id.*

169. *See id.*

170. *See id.*

methyl bromide treatment, the economic returns for metam sodium far outweighed those of methyl bromide, a promising result for farmers needing a replacement for methyl bromide soil fumigation.[171]

In studies conducted in Florida, the EPA found that metam sodium is also equally effective as methyl bromide in treating tomato crops.[172] Metam sodium "significantly reduced" fusarium crown and root rot, the most prevalent soilborne disease in southwest Florida.[173]

3. *Telone® and Tillam®*

A combination of Telone® C-17 and Tillam® is another alternative to methyl bromide in certain circumstances.[174] Telone® C-17, produced by DowElanco, is generally recognized as an effective preplant nematicide.[175] Tillam® 6E is a selective herbicide, whose active ingredient is pebulate, and is often used in conjunction with Telone® products for weed control.[176]

In a study conducted by the at the North Florida Research and Education Center, researchers found that the combination of Telone® C-17 and Tillam® on Florida tomatoes produced a higher yield of medium and large fruit than did the combination of methyl bromide and chloropicrin, a pesticide similar to methyl bromide and often used in conjunction with it.[177] In fact, in several studies using the combinations researchers found that the Telone® C-17 and Tillam® team performed as effectively, if not more effectively, than the methyl bromide-chloropicrin combination.[178]

Of course Telone® has its side effects. One of the disadvantages of Telone® products is that it poses some danger to farm workers.[179] One way to reduce the hazard to workers, however, is through drip irrigation.[180] Another disadvantage is the fact that the total material cost of the Telone® C-17 and Tillam® combination is $247 per acre, compared to the total material cost of the methyl bromide and chloropicrin combination at $224 per acre.[181] Additionally, the EPA has classified Telone as a sus-

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171. *See id.*
172. *See id.*
173. *Id.*
174. *See* 3 OFF. OF AIR & RADIATION, EPA, *Replacing Methyl Bromide for Preplant Soil Fumigation with Telone®, Chloropicrin and Tillam® Combination Treatments, in* ALTERNATIVES TO METHYL BROMIDE: TEN CASE STUDIES: SOIL, COMMODITY, AND STRUCTURAL USE (1997) [hereinafter *Replacing Methyl Bromide for Preplant Soil Fumigation*].
175. *See id.*
176. *See id.*
177. *See id.*
178. *See* id.
179. *See generally id.* (stating some of these side effects include possible contamination of underground water systems, skin irritation, liver toxicity, and other effects).
180. *See id.*
181. *See id.*

pected carcinogen, which means that any use of the product is restricted.[182] Despite the slightly increased cost of the Telone® C-17 and Tillam® combination, it is still considered a viable alternative to methyl bromide in certain uses because of its excellent disease-control capabilities.[183]

The parent compound of Telone® is InLine, a water-soluble formulation, whose active ingredient is dichloropropene.[184] When InLine was applied to strawberry crops in a test conducted by ARS labs in Fresno, California, it produced yields from 95 to 110 percent of those treated with methyl bromide.[185] InLine is currently approved for use in strawberry fields, but it has not yet been registered.[186] Despite its promising effectiveness, buffer zones must be used with InLine, and there is a limit on the amount of the chemical that each farmer can use.[187]

4. *Dazitol*

Another promising alternative is Dazitol, produced by Champon Millennium Chemicals, Inc.[188] As of late 2000, Dazitol was already patented and registered.[189] Dazitol's active ingredients are allyl isothiocyanate (which comes from essential oil of mustard) capsaicin, and other related capasaicinoids from chili peppers.[190] From studies conducted by Champon, it appears that Dazitol is a viable alternative.[191] The fact that the inventor of Dazitol and founder of Champon is Louis Champon, world-renown expert on the use of oils and plant extracts as pesticides, should ensure farmers that a successful alternative is in the near future.[192]

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182. *See* Rodriguez, *supra* note 16 (stating that restricted use pesticides require a special permit by those applicators who are actually physically applying them); *see also MB Phaseout Poses Challenge for CA Growers, supra* note 109 (farmers may start using other dangerous chemicals after the ban of methyl bromide).

183. *See Replacing Methyl Bromide for Preplant Soil Fumigation, supra* note 174.

184. *See* Marcia Wood, *Strawberry Growers Test Methyl Bromide Alternatives*, AGRIC. RES., (Jan. 1, 2001), *available at* http://www.ars.usda.gov/is/AR/archive/jan01/straw0101.html.

185. *See id., available at* http://www.ars.usda.gov/is/AR/archive/jan01/straw0101.html.

186. *See id., available at* http://www.ars.usda.gov/is/AR/archive/jan01/straw0101.html.

187. *See id., available at* http://www.ars.usda.gov/is/AR/archive/jan01/straw0101.html.

188. *See* Neil Franz, *Former USDA Chief Profits from Methyl Bromide Alternative*, CHEM. WK., Nov. 15, 2000, at 17, *available at* 2000 WL 10649558; *See also Former Agriculture Secretary Mike Espy Announces the Replacement for Methyl Bromide*, PRIMEZONE MEDIA NETWORK, Nov. 7, 2000, *available at* 2000 WL 31544152 (discussing former USDA secretary Mike Espy's membership to Champon Millennium Chemicals, Inc.'s board of directors and the USDA's delay to phase out methyl bromide until suitable alternatives were established).

189. *See generally Former Agriculture Secretary Mike Espy Announces the Replacement for Methyl Bromide, supra* note 188, *available at* 2000 WL 31544152 (discussing Dazitol's research and development).

190. *See id., available at* 2000 WL 31544152.

191. *See id., available at* 2000 WL 31544152.

192. *See id., available at* 2000 WL 31544152.

5. *Other Alternatives*

Methyl iodide, a member of the methyl bromide family, is another possible alternative.[193] Methyl iodide does not deplete the ozone layer, and it is less volatile than methyl bromide.[194] Ironically, it shows much potential as a successful fumigant, methyl iodide may never be legalized, at least in California, because of its volatility.[195]

E. *Non-Chemical Alternatives*

Chemical alternatives are not, however, the only alternatives available to farmers. Several non-chemical options are possible alternatives to methyl bromide in certain areas.[196] In some cases, states are facing enormous pressure to adopt non-chemical alternatives.[197] The Environmental Defense Center won a 1999 California state case that required the California Department of Pesticide Regulation to adopt specific regulations concerning the field fumigation use of methyl bromide.[198] After the DPR adopted those standards, the EDC again filed suit in January 2001, claiming the standards were not stringent enough.[199] Anne Schonfield, project manager for the Pesticide Action Network, stated that, "[w]e see this as no great victory for human health to switch from one extremely dangerous pesticide to another. We want to strongly encourage growers to look more seriously at nonchemical alternatives."[200]

1. *Flooding*

Flooding is one example of a non-chemical alternative in preplant soil fumigation.[201] Flooding can create anaerobic (little to no oxygen) soil conditions followed by drainage, providing an aerated (available oxygen) root environment.[202] This process decreases soil oxygen supplies so that conditions are not favorable for pests.[203] The success of flooding depends on the type of land and the type of water supplies.[204] Flooding is especially successful in flat, low-lying areas "rich in mineral soils where

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193. *See* Jill Duman, *California Vegetable Growers to Discuss Alternatives to Banned Fumigant*, MONTEREY COUNTY HERALD, Feb. 20, 2001, at E1.
194. *See id.*
195. *See id.*
196. *See* Rodriguez, *supra* note 16.
197. *See id.*
198. *See id.*
199. *See id.*
200. *Id.*
201. *See* 3 OFF. OF AIR & RADIATION, EPA, *Flooding as an Alternative to Pre-plant Methyl Bromide, in* ALTERNATIVES TO METHYL BROMIDE: TEN CASE STUDIES: SOIL, COMMODITY, AND STRUCTURAL USE (1997) [hereinafter *Flooding as an Alternative to Pre-plant Methyl Bromide*].
202. *See id.*
203. *See id.*
204. *See id.*

there are seasonally high water tables (at least 4-6 feet from the surface) and abundant water supplies (e.g., Florida and in some parts of California)."[205] In Florida, for example, the Florida Peninsula and east coast areas south of Vero Beach are likely to benefit from flooding, whereas northwest Florida and the panhandle are not likely to do so.[206]

In areas that have ample water supplies, flooding can be a cost effective alternative to methyl bromide. However, if water needs to be pumped from wells or transported, and when retention/detention pumps need to be constructed, and other capital costs are taken into consideration, flooding is probably not a viable alternative to methyl bromide.[207] However, that does not mean that one of the other numerous methyl bromide alternatives would not be successful.

2. *Solarization*

Another non-chemical alternative to methyl bromide is solarization, which is the process of heating soil by covering it with plastic sheets.[208] Solarization is based on a simple principle: heat the soil enough to kill disease, weeds, and seeds, and the crops will grow pest and residue-free.[209] This process has been tested in various field trials, and according to a University of California field assistant, the results have been promising.[210] The results are even better when solarization is combined with metam sodium usage.[211]

3. *Crop Rotation*

With regards to the use of methyl bromide in apple orchards, one possible alternative is wheat.[212] According to the ARS, "growing wheat before planting a new apple orchard on former orchard land may help prevent . . . replant disease."[213] Replant disease often strikes young plants when an old orchard is removed and a new one replaces it, without any precautionary measures being taken.[214] By including

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205. *Id.*
206. *See id.*
207. *See id.*
208. *See* Rodriguez, *supra* note 16.
209. *See id.*
210. *See id.*
211. *See id.*
212. *See Wheat May Help Prevent Apple Diseases*, OZONE DEPLETION NETWORK ONLINE TODAY, Sept. 11, 2000, *available at* 2000 WL 10445844.
213. *Wheat May Help Prevent Apple Diseases*, OZONE DEPLETION NETWORK ONLINE TODAY, Sept. 11, 2000, *available at* 2000 WL 10445844. "[R]eplant disease [is] caused by [the] buildup of four types of soilborne fungi." *Id.* Apple fields appear to support those fungi, but wheat fields modify them. *See id.*
214. *See Wheat May Help Prevent Apple Diseases*, OZONE DEPLETION NETWORK ONLINE TODAY, Sept. 11, 2000, *available at* 2000 WL 10445844.

wheat as a rotation crop in apple orchards, farmers may be able to avoid using any chemical pesticides to prevent replant disease in apples. [215] However, more research needs to be done to determine how long the wheat needs to be planted in order to alter the soil microbial community.[216]

Another example of crop rotation is found in farmers who use broccoli as a rotation crop in their strawberry fields.[217] They are finding that when the broccoli leaves are plowed under after harvest, those leaves behave as a bio-fumigant, destroying many of the deadly microorganisms in the soil.[218] However, farmers grow the broccoli for four to six years, which means losing several years of strawberry yields.[219] Thus, farmers must decide what is more important to them: higher yields of their primary crop with more environmental damage, or lower yields of their primary crop and less environmental damage. Ideally, most farmers are willing to sacrifice their crop yields in favor of protecting the environment. Realistically, however, not all farmers have the economic resources available to consider losing four years of lucrative yields.

4. *Steaming*

Steaming is also considered a strong alternative to methyl bromide with regards to soil and growth media in greenhouses and some small-scale field nurseries.[220] Steaming involves placing steam machines, ranging in size depending on the size of the application area, on the fields. Steaming kills pathogens by heating the soil to levels at which protein coagulation or enzyme inactivation occur.[221] In Florida, for example, steam cultivation has proven less expensive and sometimes more effective than methyl bromide.[222] Steaming is a clean process, leaves no residue, has no adverse effects upon humans or the environment, and can also be combined with other pest

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215. *See Wheat May Help Prevent Apple Diseases*, OZONE DEPLETION NETWORK ONLINE TODAY, Sept. 11, 2000, *available at* 2000 WL 10445844.

216. *See Wheat May Help Prevent Apple Diseases*, OZONE DEPLETION NETWORK ONLINE TODAY, Sept. 11, 2000, *available at* 2000 WL 10445844.

217. *See* Chris Clarke, *Fumigant Alternatives Ripen for Strawberry Growers*, ENVTL. NEWS NETWORK (Jan. 23, 2001), *at* http://www.enn.com/news/enn-stories/2001/01/01232001/strawberries_41466.asp.

218. *See* Chris Clarke, *Fumigant Alternatives Ripen for Strawberry Growers*, ENVTL. NEWS NETWORK (Jan. 23, 2001), *at* http://www.enn.com/news/enn-stories/2001/01/01232001/strawberries_41466.asp.

219. *See* Chris Clarke, *Fumigant Alternatives Ripen for Strawberry Growers*, ENVTL. NEWS NETWORK (Jan. 23, 2001), *at* http://www.enn.com/news/enn-stories/2001/01/01232001/strawberries_41466.asp.

220. *See* 3 OFF. OF AIR & RADIATION, EPA, *Steam as an Alternative to Methyl Bromide in Nursery Crops, in* ALTERNATIVES TO METHYL BROMIDE: TEN CASE STUDIES: SOIL, COMMODITY, AND STRUCTURAL USE (1997) [hereinafter *Steam as an Alternative to Methyl Bromide in Nursery Crops*].

221. *See id.* (citing R.W. LANGHANS, GREENHOUSE MANAGEMENT, Ch. 15 (3d ed. 1990)).

222. *See* Joel Grossman & Jamie Liebman, *Alternatives to Methyl Bromide—Steam and Solarization in Nursery Crops*, THE IPM PRACTITIONER, July 1995, at 1.

control methods.[223] The success of steaming in the future will depend a lot on the reduction of the price of the steam machines.

5. *Hydroponics*

As previously discussed, hydroponics is an alternative already being used worldwide, most notably in Canada and the Netherlands.[224] Hydroponics involves treating certain crops with a nutrient solution, a mixture of water and water-soluble nutrients.[225] Hydroponics is a good alternative to methyl bromide soil fumigation for tomatoes, strawberries, and some other vegetables.[226] There are two types of hydroponics operations: closed, where the nutrient solution is recycled by the crop; and open, where the solution is discharged after use.[227]

The EPA has enumerated the three prominent advantages of hydroponics in greenhouse crops:

1) an absence of completing weeds and soilborne pests and toxic residues;

2) water conservation (with recycling systems, hydroponic systems use one tenth the amount of water used in irrigated agriculture); and

3) conditions that can be altered quickly to suit specific crops, various growth stages, and environmental/climate conditions.[228]

The cost of hydroponics is another advantage. Despite the materials' costs being higher for hydroponics than for methyl bromide, the farmer's operating costs are less, and overall crop yields are higher than those treated with methyl bromide.[229] Experts expect the costs of hydroponics to decrease as the process becomes more commercialized.[230]

Other than the aforementioned alternatives to methyl bromide, farmers have other options available to them to alleviate the loss of methyl bromide. For example, scientists are experimenting with a new tarp that is made from "virtually impermeable films."[231] Members of the ARS in Riverside, California, have tested numerous fumigants using the new tarps and have found that emissions were reduced five to fifteen

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223. *See id.*

224. *See Alternatives to Methyl Bromide Needed Before Phaseout, Say Experts, supra* note 96, *available at* 2000 WL 12049473; *see also* 3 OFF. OF AIR & RADIATION, EPA, *Hydroponics and Soilless Cultures on Artificial Substrates as an Alternative to Methyl Bromide, in* ALTERNATIVES TO METHYL BROMIDE: TEN CASE STUDIES: SOIL, COMMODITY, AND STRUCTURAL USE (1997) [hereinafter *Hydroponics and Soilless Cultures on Artificial Substrates as an Alternative to Methyl Bromide*].

225. *See Hydroponics and Soilless Cultures on Artificial Substrates as an Alternative to Methyl Bromide, supra* note 224.

226. *See id.*

227. *See id.*

228. *Id.*

229. *See id.*

230. *See id.*

231. Vick, *supra* note 11, *available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf..

percent.[232] That is promising news for farmers who do not want to try a nonchemical alternative, but want to reduce the emissions from whatever chemical fumigant they do choose. It also means that farmers can further reduce methyl bromide emissions until the phase out is complete.[233]

As previously stated, the majority of methyl bromide use in the United States is for fumigation purposes. But as stated in Section I, methyl bromide is also used in structural fumigation and commodities. And methyl bromide users in those other areas also need to find alternatives to it. Some alternatives in the structural fumigation area are sulfuryl fluoride and phosphine, as well as some nonchemical alternatives, including nitrogen and heat.[234] Some alternatives for commodity use include phosphine and carbon sulfide.[235] Some nonchemical choices include nitrogen and heat.[236] Although the focus of this Note has been on the use of methyl bromide for soil fumigation, it is important to remember that the methyl bromide phase out affects all users of the chemical.

VI. CONCLUSION

Methyl bromide, one of the most popular and efficient pesticides in use, continues to fuel controversy. Despite the fact that the phase out is on schedule and will be complete in 2005, producers of methyl bromide and farmers, among others, are still holding out hope that somehow they will find a way to continue producing and using methyl bromide. In reality, their only hope is for viable alternatives to replace methyl bromide. And as discussed in Section V., infra, several viable alternatives do exist.

But it is important to remember that not every alternative to methyl bromide will work for all uses. As of today, there is no single blanket substitute for methyl bromide.[237] Hydroponics works well for greenhouse-grown tomatoes and strawberries, but not so well for traditionally grown crops.[238] Flooding works well only in flat, low-lying areas near an ample water supply.[239] Certain fumigants that work well for strawberries may kill tomatoes, and vice versa.[240] In fact, the lack of a universal substitute has caused enough concern among the parties to the Montreal Protocol that the parties have agreed to discuss the problem in 2003, two years before the phase out is

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232. *See id. available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf.

233. *See id. available at* http://www.ars.usda.gov/is/AR/archive/jan01/form0101.pdf.

234. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

235. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

236. *See* EPA, *U.S. EPA Methyl Bromide Phase Out Web Site, at* http://www.epa.gov/docs/ozone/mbr/mbrqa.html (last modified Oct. 3, 2001).

237. *See* Duval, *supra* note 132, at 621.

238. *See Hydroponics and Soilless Cultures on Artificial Substrates as an Alternative to Methyl Bromide Soil Fumigation, supra* note 224.

239. *See id.*

240. *See id.*

complete.[241] ARS scientists in California feel that a wide variety of chemical substitutes and non-chemical substitutes will be used to fill the void that methyl bromide is leaving behind.[242] And it appears that ARS is correct.

It is important to realize alternatives do in fact exist.[243] And as the phase out continues, more and more alternatives will be tested and used. Some critics argue that the phase out should not continue until viable alternatives for all methyl bromide uses have been found.[244] However, the phase out itself may actually encourage the development of alternatives, and in less time than if there were no phase out. If farmers realize that methyl bromide will never be available to them in the future, they will have to choose an alternative now if they want to stay in production. The EPA cannot continue to push back the phase out. Doing so only hurts the environment, farmers, and consumers. Currently, there may not be a perfect replacement for methyl bromide, but eventually the alternatives will do the job they are supposed to be doing. And more alternatives will continue to be developed. Also, just because the complete phase out occurs in 2005, does not mean more alternatives cannot be developed and perfected after that period. It is very important to note that all of the aforementioned alternatives, although not economically or technologically feasible for everyone at this stage in the development, are all acceptable options, and more importantly, none are being phased out. Farmers should not wait until the last minute to find an adequate alternative. They should by now be testing alternatives, if not already consistently using them.

Critics of the Montreal Protocol's phase out schedule have valid concerns. Are there any alternatives? If so, will they work well enough to curb the losses inflicted by the loss of methyl bromide? Also, why should developing countries have to be punished for a problem they did not help create? There are no easy answers for those questions. And despite these concerns, the methyl bromide phase out appears to be on schedule, as it should be.[245] Critics of the phase out place so much of their focus on the lack of alternatives while losing sight of why there is a phase out in the first place: the destruction of the ozone layer.[246] In the long run, the phase out will be very beneficial to all of the critics.

As a developed nation, the United States owes it to the rest of the world to take responsibility for its actions. If the United States and the rest of the world do not continue to take these environmental issues seriously and act accordingly, it will not

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241. *See* Cheryl Hogue and Brian Broderick, *U.S. Considering Air Act Amendment to Delay Domestic Methyl Bromide Phase out*, 20 INT'L. ENVTL. REP. (BNA) 904, 905 (1997).

242. *See* Wood, *supra* note 184, *available at* http://www.ars.usda.gov/is/AR/archive/jan01/straw0101.html.

243. *See* Chris Clarke, *Fumigant Alternatives Ripen for Strawberry Growers*, ENVTL. NEWS NETWORK (Jan. 23, 2001), *at* http://www.enn.com/news/enn-stories/2001/01/01232001/strawberries_41466.asp.

244. *See MB Phaseout Has Farmers Worried*, *supra* note 17, *available at* 2000 WL 10445790.

245. *See id.*, *available at* 2000 WL 10445790.

246. *See* Goldschein, *supra* note 1, at 609.

matter whether or not a farmer can use methyl bromide. The destruction of the ozone layer is doubtlessly affecting the entire ecological system and it is time to draw the line and accept the phase out. Too much time and energy already have been wasted arguing to extend the phase out, or to repeal it completely. That time and energy is better spent on focusing on developing and perfecting alternatives for methyl bromide.