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# Facing the Phaseout Of Methyl Bromide

With the agricultural pesticide methyl bromide being phased out by parties to the Montreal Protocol, public and private sector efforts are underway to develop effective alternatives. Methyl bromide is an agricultural pesticide that has been used for over 50 years to control insects, pathogens, nematodes, and weeds in vegetable, fruit, and nut crops. It is used for soil fumigation before planting, post-harvest fumigation of agricultural products in storage and prior to shipment, and for government-required quarantine treatment of commodities to prevent the spread of pests.

Methyl bromide has been classified as a substance that depletes the stratospheric ozone layer. The ozone layer protects the earth against the most harmful types of radiation from the sun, so depletion of this layer may increase the incidence of skin cancer, sunburn, eye damage, and other adverse effects. To address these potential dangers, an international agreement, the Montreal Protocol, was reached in 1987 to control or phase out use of chemicals that may be contributing to loss of the ozone layer. Methyl bromide was included in this agreement in 1992 and is now subject to an international phaseout.

Many U.S. users, including growers and the food industry, are concerned that alternative practices currently available to replace methyl bromide use will be less effective, resulting in financial losses. In response to these concerns, USDA, the Environmental Protection Agency, state universities, and private firms are working to develop new alternatives. As part of USDA's contribution to this effort, the Economic Research Service has cooperated with the National Center for Food and Agricultural Policy (NCFAP) and the University of Florida in analyzing the economic tradeoffs of these alternatives and of the phaseout itself.

## *U.S. Use Heaviest In Florida & California*

Most methyl bromide is used in the U.S. for soil fumigation prior to planting crops to control a broad spectrum of insects, pathogens, nematodes, and weeds. NCFAP estimates that about 35 million pounds of active ingredient are used for that purpose annually. Use on tomatoes accounts for 30 percent of the total, strawberries for 19 percent, and peppers for 14 percent. Another 16 percent is used on perennial crops such as almonds, grapes, peaches, nectarines, plums, prunes, and walnuts. Ornamentals and nursery crops, including strawberry and fruit tree transplants, rose plants, and tobacco seedlings, account for 6 percent. The remainder is used on other vegetable crops.

California and Florida are the states with the largest methyl bromide use in the U.S. Over 90 percent of Florida's acreage in fresh-market tomatoes, strawberries, and peppers was treated in 1996, the most recent year for which data are available. Cucumbers, squash, and watermelons that are double-cropped with tomatoes or peppers in Florida also benefit from this use of methyl bromide. Over 75 percent of eggplant acres in Florida was treated in 1996, although this accounts for only a small amount of the methyl bromide used in the state.

In California, growers treated 90 percent of strawberry acres in 1996. Methyl bromide is also widely used to control soil pests from previously planted perennials before replanting orchards and vineyards. Agricultural nurseries use the pesticide to produce vigorous transplants of strawberries, perennials, and other crops, and to meet a California requirement that transplants be pest-free for transporting. Most producers of organic strawberries in California use transplants grown in soil treated with methyl bromide.

Post-harvest treatments with methyl bromide protect the quality of commodities in storage and allow handlers to meet FDA sanitary standards. Large quantities of dates, figs, raisins, almonds, and walnuts produced in California are routinely treated before and periodically during storage. Walnuts exported for European holiday markets are treated to meet import standards. Methyl bromide is also used to treat mills, ships, and structures for pest control.

Many governments require quarantine treatments with methyl bromide for imports of food and other commodities to prevent the spread of damaging pests. Fresh fruit imported from Chile, including grapes, peaches, nectarines, and kiwifruit, accounted for over 85 percent of the value of food imports required to receive methyl bromide quarantine treatments for entry into the U.S. in fiscal year 1996. Methyl bromide is also used as a domestic quarantine treatment for such crops as citrus

produced in Florida and Texas and for blueberries produced in the Southeast before shipment to western states.

In recent years, some U.S. exports of sweet cherries, peaches, nectarines, plums, prunes, apricots, dates, dried prunes, walnuts, oak logs, cotton, rice, and tobacco were treated to meet the requirements of importing countries. In addition, California strawberries exported to Japan are treated for quarantine pests not found in that country.

## *Montreal Protocol Controls Phaseout*

Under the Montreal Protocol, methyl bromide consumption is being phased out internationally. The treaty, signed by over 160 countries, controls the global production and trade of ozone-depleting substances. Methyl bromide was classified as an ozone-depleting substance in 1992. In 1997, parties to the Montreal Protocol agreed that methyl bromide consumption (defined in the Protocol as production plus imports minus exports) should be phased out by 2005. The reduction will take place in stages: a 25-percent reduction from a 1991 baseline in 1999; a 50-percent reduction in 2001; a 70-percent reduction in 2003; and a 100-percent reduction in 2005. Developing countries agreed to freeze methyl bromide use in 2002 at a 1995-98 average and to reduce consumption from that baseline by 20 percent in 2005. Developing countries will reach 100-percent reduction in 2015.

The treaty exempts quarantine and preshipment uses from the phaseout. It remains unclear which post-harvest uses will be classified as preshipment—this term and its temporal limitations have yet to be defined. The treaty also allows countries to exempt critical uses after 2005, if a country determines that no technically and economically feasible alternative is available with acceptable health and environmental effects and that significant market disruption would occur if methyl bromide were unavailable. The country would have to take technically and economically feasible steps to minimize methyl bromide use and emissions and conduct research on developing and deploying alternatives.

In the U.S., the Montreal Protocol is implemented through the Clean Air Act. In December 1993, EPA issued a regulation under the Clean Air Act that would terminate U.S. production and importation of methyl bromide by January 1, 2001. The regulation required a more rapid elimination schedule than the Montreal Protocol and did not exempt preshipment, quarantine, or critical uses. U.S. grower and industry groups argued that the regulation gave foreign competitors an unfair advantage in growing and storing crops, which would disrupt international trade. Many agricultural scientists argued that developing cost-effective alternatives required more time. As a result, Congress amended the Clean Air Act in October 1998 to harmonize the U.S. phaseout with the Montreal Protocol.

## *Limited Alternatives Concern Users*

Public and private research programs, including potential suppliers, are examining a variety of potential alternatives, some fairly well developed and others relatively new. Studies of preplant uses that measure performance in terms of yield have focused on Florida tomatoes and California strawberries; fewer studies have been conducted for other vegetables, orchard crops, vineyards, ornamentals, and nursery crops, leaving uncertainty about the relative performance of potential alternatives for these crops. These studies also have focused on older, registered pesticides; less yield performance information is available for other alternatives. Uncertainties also continue about weed control alternatives that might complement practices that control other pests to achieve the broad-spectrum control offered by methyl bromide use.

Based on available performance studies and researcher judgments, the most likely chemical alternative for most preplant uses is Telone (1,3-D and chloropicrin) or chloropicrin in combination with a pesticide such as pebulate (Tillam), napropamide (Devrinol), or metam sodium (Vapam). Metam sodium might be used where preplant use of Telone is restricted. To provide better pest control, a year of fallow may be needed with chemical alternatives for some California perennial crops.

**U.S. Preplant Use of Methyl Bromide Is Greatest for Tomatoes**

| Crop | Quantity* |
|---|---|
| | *(1,000 lbs.)* |
| Tomatoes | 10,383 |
| Strawberries | 6,601 |
| Peppers | 4,741 |
| Grapes | 2,511 |
| Nurseries | 2,115 |
| Almonds | 1,070 |
| Lettuce | 936 |
| Carrots | 795 |
| Tobacco | 657 |
| Nectarines | 546 |
| Watermelons | 545 |
| Peaches | 520 |
| Plums/prunes | 513 |
| Cucumbers | 441 |
| Sweet potatoes | 393 |
| Eggplants | 262 |
| Walnuts | 260 |
| Citrus | 89 |
| Asparagus | 75 |
| Cantaloupes | 66 |
| Cherries | 62 |
| Broccoli | 50 |
| Onions | 45 |
| Cauliflower | 41 |
| Raspberries | 26 |
| Apples | 10 |
| Brussels sprouts | 4 |
| Avocados | 2 |
| Apricots | 1 |
| Other | 639 |
| Total, preplant uses | 34,399 |

Annual use
*Active ingredient.
Source: National Center for Food and Agricultural Policy, 1999.
Economic Research Service, USDA

Agricultural scientists have been examining a variety of nonchemical methods, and some may have an important role in the future. Currently, scientists at the University of Florida and USDA's Agricultural Research Service indicate that solarization, a technique that traps solar heat with transparent film to suppress soil pests, may be feasible on limited acreage for fall tomato production. Steam, which requires boilers and other equipment to heat the soil, may be a feasible alternative for greenhouse production of some ornamentals.

In most cases, researchers expect currently available alternatives to be less effective than methyl bromide. Researchers expect lower yields for tomatoes, strawberries, peppers, eggplants, second

**Impact of Banning Methyl Bromide for Preplant Use Varies by Crop**

| U.S. crop | Annual net impact | Impact as share of crop value[1] |
|---|---|---|
| | *$ million* | *Percent* |
| **Annuals**[2] | | |
| Eggplants | 3.5 | 25 |
| Strawberries | 131.5 | 19 |
| Squash | 5.8 | 16 |
| Peppers | 16.1 | 6 |
| Tomatoes | 30.4 | 4 |
| Watermelons | 9.8 | 4 |
| Cucumbers | 2.4 | 3 |
| Total, annuals | 199.5 | |
| **Perennials**[3] | | |
| Nectarines | 8.0 | 7 |
| Almonds | 45.7 | 4 |
| Grapes | 75.4 | 3 |
| Peaches | 5.7 | 2 |
| Prunes | 4.9 | 2 |
| Walnuts | 3.4 | 1 |
| Total, perennials | 143.2 | |
| **Nurseries and ornamentals**[4] | | |
| Sod (GA, FL, CA) | 59.6 | 33 |
| Rose plant nurseries (CA) | 6.3 | 18 |
| Perennial nurseries (CA) | 18.6 | 15 |
| Strawberry nurseries (CA) | 2.9 | 15 |
| Tobacco seedlings (FL, GA, TN) | 5.7 | 10 |
| Caladium (FL) | 1.2 | 7 |
| Cut flowers (FL, CA) | 14.4 | 5 |
| Total, nurseries and ornamentals | 108.7 | |
| **Total, preplant uses** | 451.4 | |

1. Percent of value in selected major producing states. 2. Sum of annual impacts on U.S. producers and consumers. 3. Net present value of impact, over life of orchard, on acres treated in 1 year. 4. Net present value of impact for rose plants and sod. Partial budgeting impact (change in producer net income, assumes constant price) for other nurseries and ornamentals.
Source: National Center for Food and Agricultural Policy, 1999.

Economic Research Service, USDA

crops in Florida double-cropping systems (cucumbers, watermelons, or squash), perennials, ornamentals, and nursery crops. Over time, increasing infestations of pests currently controlled by methyl bromide could lead to larger yield losses.

In addition, Federal and state regulations could limit or ban the use of currently available chemical pesticides, forcing growers to use less effective alternatives. California currently has township-level use restrictions for Telone and may limit chloropicrin use due to concerns about air quality. California nursery industry representatives and researchers indicate that if neither methyl bromide nor Telone were available, growers could not sell nursery stock when nematodes are found in the soil, making orchards less productive and profitable.

In 31 Florida counties, Telone use is restricted to certain soil conditions to protect groundwater. Where Telone use is allowed, the high cost of personal protective equipment required for working with Telone, and the difficulty of recruiting labor to wear the equipment in hot weather, might cause growers to use a broadcast application system, which could be less effective than more labor-intensive traditional methods. Moreover, napropamide and pebulate, herbicides that could be used with Telone to replace the weed control provided by methyl bromide, have Federal label restrictions that could prevent their use in Florida. Several new chemical alternatives that might reduce the financial impacts of methyl bromide loss, such as basamid (already registered for nonfood use), methyl iodide, and propargyl bromide must await registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

For post-harvest uses on dried fruits and nuts that might not be exempt from the phaseout, phosphine is the most likely alternative, but phosphine treatments require more time than methyl bromide to be effective, which could lead to lost marketing opportunities. For example, walnut industry representatives argue that if currently available alternatives such as phosphine were used, some walnuts could not be processed quickly enough for holiday-season shipment to European markets. This would result in a loss of high-value sales and would divert these walnuts to domestic markets, increasing the supply and thereby reducing domestic prices.

Phosphine may also have a detrimental impact on the flavor of walnuts. Adding further to the costs of phosphine as a methyl bromide alternative, storage facilities using the chemical require better sealing to prevent leakage and require protection of electrical equipment from the corrosive effects of phosphine.

EPA has proposed restrictions on phosphine that could prevent use in some storage facilities, in response to concerns about acute toxicity and the danger of worker and bystander exposure. EPA extended its review schedule to consider public input and examine more options to reduce risks and intends to revise the proposal in August 1999.

## *Economic Estimates Help Target Mitigation Efforts*

Based on current knowledge about alternatives to methyl bromide, the planned phaseout will cause substantial short-term losses to U.S. producers and consumers of crops treated with methyl bromide. This situation will last until more cost-effective alternatives are available. NCFAP researchers estimate that the net annual loss from banning methyl bromide for preplant use on selected crops would be about $450 million—$200 million for annuals (strawberries, tomatoes, and other vegetables), $140 million for perennial crops, and $110 million for ornamental and nursery crops.

NCFAP also estimates that phosphine use for post-harvest treatments that might not be exempt from the phaseout would increase costs for dates, figs, prunes, raisins, and walnuts by $2 million. Impacts on these post-harvest uses would actually be greater than that amount because the estimate doesn't include costs of retrofitting storage facilities, increasing storage time or altering processing to accommodate longer treatment times, or for losses from missed market opportunities or detrimental flavor impacts on walnuts.

In estimating the costs of phasing out methyl bromide, University of Florida and NCFAP researchers modeled markets for strawberries, tomatoes, and other vegetable crops—commodities that are among the largest users of methyl bromide. They estimated that if currently available alternatives were used, U.S. production of tomatoes, peppers, eggplants, and strawberries would decline, especially in states dependent on methyl bromide use. The University of Florida study estimated that Florida and California would each lose about $200 million in f.o.b. (gross shipping point) revenues. As a consequence, U.S. consumers would face higher prices and reduced supply.

The models also estimated the U.S. would increase imports of Mexican-produced tomatoes, peppers, and eggplants. While Mexico does not currently have a large share of the U.S. fresh strawberry market, the methyl bromide phaseout could create opportunities for Mexico or other countries to increase production for the U.S. market. Mexico is much less reliant on methyl bromide for producing these crops than Florida or California, and as a developing country, is not required under the Montreal Protocol to phase out methyl bromide completely until 2015. Thus, the phaseout will have little immediate effect on Mexican costs and yields. For consumers, increased imports from Mexico would have a positive effect, by reducing U.S. price increases and supply losses.

These estimates can help target efforts to mitigate the economic impact of phasing out methyl bromide uses by showing which reductions in use will cause the greatest losses. Focusing on the larger aggregate impacts emphasizes the effects on such crops as strawberries, tomatoes, peppers, and perennials, which use relatively large quantities of methyl bromide. Since the proportional impact on smaller uses could be severe despite small absolute losses, calculation of returns per pound of methyl bromide, and comparison to the next best alternative, also helps identify significant potential problems.

For preplant uses, NCFAP researchers estimated the highest returns per pound of methyl bromide for strawberries in Florida and California; wine grapes, almonds, perennial nurseries, sod and flowers in California; tomatoes or peppers double-cropped with watermelons, cucumbers, or squash in Florida; and tomatoes in southern California. Estimates of impacts for these uses range from about $10 to $95 per pound of methyl bromide. (An impact of $0 per pound means that there is an equally cost-effective alternative.) Post-harvest uses, which account for relatively small quantities of methyl bromide, are also particularly valuable if commodities left untreated would be excluded from high-priced markets or face discounted prices because of poor quality.

Results of NCFAP and University of Florida studies point to progress in developing alternatives that will reduce the impacts of methyl bromide loss for some uses. The NCFAP impact estimate of $450 million for preplant use, for example, is considerably less than an estimate of about $800 million for the same uses made in 1993 by the National Agricultural Pesticide Impact Assessment Program. Similarly, University of Florida researchers estimated a decline in f.o.b. revenues from Florida tomatoes in 1995 of about $400 million, but currently estimate a decline of about $70 million. The reductions in yield loss estimates are the result of new research that showed the relative effectiveness of the Telone-plus-pebulate combination as an alternative to methyl bromide, but pebulate might not be available unless regulatory issues are resolved. However, the current University of Florida study also indicates that alternatives for fruit and vegetable crops must be even more cost-effective than currently expected if methyl bromide-reliant regions are to maintain market shares within 10 percent of their current levels. This result shows a need for further research to develop alternatives.

Several efforts are underway to design transition strategies that will help producers adjust to the methyl bromide phaseout and mitigate its economic impact. Research to develop new alternatives—as well as new methods for using currently available alternatives more effectively—continues. To address regulatory issues, USDA and EPA conducted a series of meetings with researchers and users in the spring and summer of 1999 to assess which pesticide alternatives might need label or registration changes in order to make them available to growers. In the end, if economically feasible and environmentally acceptable alternatives are not available for some uses in 2005, those that meet the criteria for critical uses might be exempted from the phaseout. However, efforts to reduce methyl bromide use and emissions and to develop alternatives would have to continue. **AO**

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**Upcoming Reports—USDA's Economic Research Service**

The following reports will be issued electronically on dates and at times (ET) indicated.

**August**

| | |
|---|---|
| 12 | *World Agricultural Supply and Demand Estimates (8:30 am)* |
| 13 | *Cotton and Wool Outlook (4 p.m.)*** |
| | *Oil Crops Outlook (4 p.m.)*** |
| | *Rice Outlook (4 p.m.)*** |
| 16 | *Feed Outlook (9 a.m.)*** |
| | *Wheat Outlook (9 a.m.)*** |
| 20 | *Agricultural Outlook** |
| 24 | *Livestock, Dairy, and Poultry (4 p.m.)*** |
| | *U.S. Agricultural Trade Update (3 p.m.)* |
| 30 | *Outlook for U.S. Agricultural Trade** |

*Release of summary, 3 pm
**Available electronically only