METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE FOR ORCHARD REPLANT

FOR ADMINISTRATIVE PURPOSES ONLY:	
DATE RECEIVED BY OZONE SECRETARIAT:	
YEAR:	CUN:

NOMINATING PARTY:	The United States of America
BRIEF DESCRIPTIVE TITLE OF NOMINATION:	Methyl Bromide Critical Use Nomination for Preplant Soil Use for Orchard Replant

NOMINATING PARTY CONTACT DETAILS

Contact Person:	John E. Thompson, Ph. D.
Title:	International Affairs Officer
Address:	Office of Environmental Policy U.S. Department of State 2201 C Street N.W. Room 4325 Washington, DC 20520 U.S.A.
Telephone:	(202) 647-9799
Fax:	(202) 647-5947
E-mail:	ThompsonJE2@state.gov

Following the requirements of Decision IX/6 paragraph (a)(1), the United States of America has determined that the specific use detailed in this Critical Use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption.

X Yes ☐ No

CONTACT OR EXPERT(S) FOR FURTHER TECHNICAL DETAILS

Contact/Expert Person:	Tina E. Levine, Ph.D.
Title:	Division Director
Address:	Biological and Economic Analysis Division Office of Pesticide Programs U.S. Environmental Protection Agency Mail Code 7503C Washington, DC 20460

	U.S.A.
Telephone:	(703) 308-3099
Fax:	(703) 308-8090
E-mail:	levine.tina@epa.gov

LIST OF DOCUMENTS SENT TO THE OZONE SECRETARIAT IN OFFICIAL NOMINATION PACKAGE

List all paper and electronic documents submitted by the Nominating Party to the Ozone Secretariat

1. PAPER DOCUMENTS: Title of Paper Documents and Appendices	Number of Pages	Date Sent to Ozone Secretariat

2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: Title of Electronic Files	Size of File (kb)	Date Sent to Ozone Secretariat

TABLE OF CONTENTS

LIST OF TABLES

PART A: SUMMARY

1. NOMINATING PARTY

The United States of America (U.S.)

2. DESCRIPTIVE TITLE OF NOMINATION

Methyl Bromide Critical Use Nomination for Preplant Soil Use for Orchard Replant

3. CROP AND SUMMARY OF CROP SYSTEM

The Orchard Replant sector represents stone fruit, almond, and walnut orchards, and table grape and raisin vineyards, in California. Growers of all of these commodities face a common threat—a poorly understood disease complex called "orchard replant problem" or "disorder". The disorder can be of varying severity depending on orchard location, crop, soil texture, soil moisture, or other factors. Orchards with replant problem have several visible effects, the first and most apparent is poor tree growth during the early years of establishment (rejection component) and in some cases a slow and detrimental decline in root health and plant growth caused primarily by pathogenic nematodes and fungi. Environmental interactions and damage by other pests (e.g., insects, nutrient deficiency or wind blow-down) are less well documented, but anything that limits early development of root growth can predispose the trees to greater damage from subsequent agents. The long life of a productive orchard (20 to 40 years) necessitates a long-term approach to orchard management. Typically, the first step in the establishment of an orchard on land previously planted to orchard crops, is ripping the soil and then fumigating. These eliminate (or reduce) both pests and remnant roots of previous plantings that harbor the pests. *This pre-plant fumigation occurs only once in the life of the orchard*, and therefore, the most cost effective but deep penetrating treatment is sought by growers. In the past both methyl bromide (MB) and 1,3-dichloropropene (1,3-D) have been the standards for orchard replant, however the use label for 1,3-D was revised in the mid-1990s with rate and use restriction. Consequently, 1,3-D is not effective in many orchard replant situations, which makes MB a critical tool to an orchard's long-term productivity.

The typical practice of replanting orchards or vineyards with MB is to remove the old trees after the final harvest. The soil is harrowed and the remaining roots are removed. The soil is fumigated in the late fall and the trees are replanted in late winter. With MB growers have usually not needed to leave a fallow period between tree removal and the replanting of the new trees. In a minority of orchard replant sites, 1,3-D, sometimes in combination with chloropicrin, can be an alternative to MB. However, it is only effective in orchards with sandy soils where moisture levels at over 1 meter depth are reduced (and where township restrictions do not apply). When it is used, 1,3-D is applied after removal of old trees, followed by soil ripping and deep soil drying and then land leveling where needed. Depending on soil texture, availability of preferred new cultivars, and finances of the enterprise, the land is left fallow for one year to accomplish all these activities.

4. Methyl Bromide Nominated

Table 4.1: Methyl Bromide Nominated

Year	Nomination Amount (kg)	Nomination Area (ha)
2006	**859,758**	**2,698**

5. Brief Summary of the Need for Methyl Bromide as a Critical Use

The US nomination is only for those areas where the alternatives are not suitable. In U.S. orchard replant production there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in orchard replant.
- geographic distribution of key target pests: i.e., some alternatives may be comparable to methyl bromide as long as key pests occur at low pressure, and in such cases the US is only nominating a CUE where the key pest pressure is moderate to high.
- regulatory constraints: e.g., 1,3-D use is limited in California due to the township caps.
- soil conditions may not be suitable for use of the alternative. For example heavy soils retain water longer may not be suitable for the use of 1,3-D.

The U.S. Nomination is for areas within this sector where alternatives are not suitable, either because of legal restrictions or physical features such as unacceptable soil moisture. For most sites of orchard replant with stone fruit, grapes, walnuts, and almonds in California, MB is a critical tool for establishing healthy, long lived orchards. Only some of the orchard sites in California are currently able to effectively use alternative measures to manage orchard replant disorder, the disease complex that is associated with various pathogens (primarily nematodes, some fungi, and possibly at least one insect species) and environmental forces such as soils, moisture, climate, and nutrition (Browne et al., 2002b; McKenry, 1999).

Many aspects of the etiology of this disease complex are currently not known. "Orchard replant problem" or "disorder" presents a difficult challenge to growers when replanting orchards and vineyards, considering the long-term investment (typically fruit orchards and vineyards can produce for 20-25 years, walnut orchards can produce for 40 years, and almond orchards produce on average 25-30 years) that is necessary for fruit and nut orchard production. Because of the perennial nature of orchards, fumigation of orchards occurs only once during the bearing life of the trees, and so the most efficient system to produce the healthiest trees is necessary to avoid early tree removal, added costs, and lost revenue due to necessity of planting and then replanting orchards if replant disorder is not initially addressed.

According to an in-depth report on orchard replant (McKenry, 1999), in 1999 at least 85% of the California walnut acreage is infested with one or more problem nematodes (*Pratylenchus vulnus*, *Criconemella xenoplax*, or *Meloidogyne* spp.). No rootstocks are currently available that have sufficient resistance to control these pests. About 60% of vineyards are infested with problem nematodes, although tolerant rootstocks can help ameliorate the replant problem for some nematodes. However, vineyards are also susceptible to Phylloxera and Armillaria root rots. At least 60% of cling peach areas are infested with *Criconemella xenoplax* and another 35% of stone fruit plantings are infested with *P. vulnus* or *C. xenoplax*. Around 35% of almond plantings are infested with *C. xenoplax* and/or *P. vulnus;* 15% of almond orchards are infected with bacterial canker, and 5% are infected with oak root fungus.

Replant disorder is mediated by environmental conditions or stress, such that management can be effective in some areas but not in others. Effective fumigation prior to replanting orchards can reduce pest populations to 99.9% in the top 1.5 meters while killing remnant roots from previous orchard trees. Even if pests can be sufficiently controlled, old plant roots must be removed or made unavailable as nutrients over a period of time to allow the establishment of healthy, actively growing trees. For the fruit and nut industries, MB is critical, especially considering the once in an orchard-life (20-40 years) fumigation requirement.

It has long been observed that fumigation improves the growth of trees in the beginning stages of orchard establishment—"…even 'resistant' rootstocks grow poorly their first year or two without such soil treatments" (McKenry, 1999). An effective pre-plant fumigation should kill 99.9% of nematode pests in the top 1.5 meters of orchard soils, and should kill the roots remaining from the previous orchard planting (McKenry, 1999). If growers relied on post-planting drip treatments it would be difficult to achieve greater than 50-75% nematode control for longer than 6-9 months—especially since no remnant roots are killed, allowing a refuge for nematode pests. Pre-plant fumigation also provides a means for avoiding repeated post-plant nematicide applications during the years following planting; thus reducing costs and further pesticide applications. Thus, the importance of an effective pre-plant fumigation treatment is critical to an orchard's survival as an ongoing commercial operation.

Prior to 1990, 1,3-D was considered at least as good as MB for treatment of replant problem (McKenry, 1999). However, due to environmental and health concerns (it is a B2 carcinogen and was found off of treatment sites) 1,3-D was banned and MB became the predominant treatment for orchard replant. With the re-labeling of 1,3-D in the mid-1990s there were new restrictions on its use and application rate, including township caps in California, and reduced rates that were considered ineffective for some severe replant situations (reduced to 325 kg/ha from 427 kg/ha). MB, therefore, remains the standard for the industry when establishing nearly all of California's orchards, except in the few with light soils, with appropriate moisture conditions, where lower rates of 1,3-D can be effective (McKenry, 1999). [Each township is allowed a maximum of approximately 41,000 kg per year, in a township of approximately 9300 ha; at 225 kg/ha, 180 ha can be treated with 1,3-D per township.]

TABLE A.1: EXECUTIVE SUMMARY

Region	*California Grape and Tree Fruit League—Stone Fruit*	*California Grape and Tree Fruit League—Raisin & Table Grapes*	*California Walnut Commission*	*Almond Hullers & Processors Association*
AMOUNT OF NOMINATION				
2006 Kilograms	553,098	78,944	95,525	129,491
Application Rate (kg/ha)	336	357	200	364
Area (ha)	1,645	221	477	355
AMOUNT OF APPLICANT REQUEST				
2006 Kilograms	716,449	165,561	226,796	176,901
Application Rate-(kg/ha)	336	382	280	364
Area (ha)	2,131	433	809	486
ECONOMICS				
Marginal Strategy	**Best Alternative**	**Best Alternative**	**Best Alternative**	**Best Alternative**
Yield Loss (%)	Not included as there is no technically feasible alternative.	Not included as there is no technically feasible alternative.	Not included as there is no technically feasible alternative.	Not included as there is no technically feasible alternative.
Loss per hectare (US$/ha)				
Loss per kg Methyl Bromide (US$/kg)				
Loss as % of Gross Revenue (%)				
Loss as % of Net Revenue (%)				

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

The best alternative for the orchard replant sector is 1,3-D or 1,3-D with chloropicrin, and/or metam-sodium, especially in light soils. Under some soil and moisture conditions (high moisture at surface and less than 12% at 1-1.5 meters) 1,3-D can act as an effective management tool for replant problems. However, there is a critical need for MB in many orchards in California either because of legally mandated township caps for 1,3-D, or because surface moisture requirements can not be met (e.g., soils can not be adequately dried prior to use of 1,3-D).

7. (*i*) PROPORTION OF CROPS GROWN USING METHYL BROMIDE

TABLE 7.1: PROPORTION OF CROPS GROWN USING METHYL BROMIDE

REGION WHERE METHYL BROMIDE USE IS REQUESTED	AVERAGE TOTAL CROP AREA IN 2001 AND 2002 (HA)	PROPORTION OF TOTAL CROP AREA TREATED WITH METHYL BROMIDE (%)
California Grape and Tree Fruit League—Stone Fruit	not available (2002) [requested, 2005: 3278 ha]	90%
California Grape and Tree Fruit League—Raisin & Table Grapes	not available (2002) [requested, 2005: 433 ha]	90%
California Walnut Commission	not available (2002)	85%

	[requested, 2005: 809 ha]	
Almond Hullers & Processors Association	3,944 ha planted 2002 (of 217,570 ha total almonds)	Not available
NATIONAL TOTAL:	Not available	Not available

7. (*ii*) IF ONLY PART OF THE CROP AREA IS TREATED WITH METHYL BROMIDE, INDICATE THE REASON WHY METHYL BROMIDE IS NOT USED IN THE OTHER AREA, AND IDENTIFY WHAT ALTERNATIVE STRATEGIES ARE USED TO CONTROL THE TARGET PATHOGENS AND WEEDS WITHOUT METHYL BROMIDE THERE.

Many areas of California that are amenable to these crops have soil types and moisture characteristics that prevent alternatives from acting effectively to successfully manage replant disorder; some areas are also subject to township caps for 1,3-D, the best alternative. In addition, nearly all orchards, due to location, soil type, or other environmental conditions, are susceptible to the replant problem, and therefore, require MB fumigation prior to orchard replant. Areas with soils that contain less than 12% moisture at approximately 1.5 meters and can be sufficiently moistened in the top 30 cm, and are not restricted in their use of 1,3-D, may find 1,3-D an effective alternative to MB. In other situations, MB is the only effective treatment.

7. (*iii*) WOULD IT BE FEASIBLE TO EXPAND THE USE OF THESE METHODS TO COVER AT LEAST PART OF THE CROP THAT HAS REQUESTED USE OF METHYL BROMIDE? WHAT CHANGES WOULD BE NECESSARY TO ENABLE THIS?

Generally, it will not be possible to expand the use of the best alternative, 1,3-D to a greater percent of orchard replant situations because of physical and legal restrictions. First, at current label rates, 1,3-D can be effective in light soils, but not medium to heavy soils where moisture content below 1-1.5 meters and on the surface reduces the number of effective sites. Secondly, only if township cap limitations were reduced would there be a likelihood that 1,3-D could supplant the critical need for MB in many orchards. This is not a realistic scenario given environmental and health concerns for 1,3-D (as well as metam-sodium) in California. Furthermore, prior to label cancellation in 1990, 1,3-D was used at a higher rate (427 kg/ha) than the current maximum label rate (375 kg/ha), established after its reintroduction for perennials in 1996 (McKenry, 1999). The higher rate was considered significantly more effective than the current rate (where 1,3-D is allowed under township cap restrictions). Rates are unlikely to be increased due to the probable carcinogenic nature of 1,3-D (B2 carcinogen). Aside from township caps, efficacy of 1,3-D is highly dependent on soil type, requiring light soils to be most effective at the current label rates.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

TABLE 8.1. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION	California Grape and Tree Fruit League—Stone Fruit	California Grape and Tree Fruit League—Raisin & Table Grapes	California Walnut Commission	Almond Hullers & Processors Association
YEAR OF EXEMPTION REQUEST	**2006**	**2006**	**2006**	**2006**
KILOGRAMS OF METHYL BROMIDE	716,449	165,561	226,796	176,901
USE: FLAT FUMIGATION[a] OR STRIP/BED TREATMENT	usually Flat Fumigation [if strip—65% of area is treated]	Flat Fumigation	Flat Fumigation	usually Flat Fumigation [if strip—65% of area is treated]
FORMULATION *(ratio of methyl bromide/chloropicrin mixture)* TO BE USED FOR THE CUE	98:2	98:2	98:2	98:2
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(ha)*	2,131	433	809	486
APPLICATION RATE*[b,c] *(kg/ha)* [ACTIVE INGREDIENT]	335 (bed =65% of ha)	382	280	364
DOSAGE RATE* *(g/m²)* OF **ACTIVE INGREDIENT**	34	38.2	28	36.4

* *For Flat Fumigation treatment application rate and dosage rate may be the same.*

[a] **California Grape and Tree Fruit League—Stone Fruit** Various methods are used depending on the particular nursery, fumigation can be flat fumigation, strip, or even "by the hole" (for individual tree replacement; MB is the only product that has acceptable technology for hole application—approximately 0.5 kg/tree).
[b] **California Grape and Tree Fruit League—Stone Fruit** Requested rate of 219 kg/ha is dose rate (21.9 g/m^2) rather than rate applied as if entire hectare were treated (335 kg/ha).
[c] **Almond Hullers & Processors Association** Various methods are used depending on the particular nursery, fumigation can be Flat Fumigation, strip, or even "by the hole" (for individual tree replacement; MB is the only product that has acceptable technology for hole application—approximately 0.5 kg/tree).

9. Summarize Assumptions Used to Calculate Methyl Bromide Quantity Nominated for Each Region:

The amount of methyl bromide nominated by the U.S. was calculated as follows:

- The percent of regional hectares in the applicant's request was divided by the total area planted in that crop in the region covered by the request.
- Hectares counted in more than one application or rotated within one year of an application to a crop that also uses methyl bromide were subtracted. There was no double counting in this sector.
- Growth or increasing production (the amount of area requested by the applicant that is greater than that historically treated) was subtracted.
- Quarantine and pre-shipment (QPS) hectares is the area in the applicant's request subject to QPS treatments. QPS did not apply to this sector.
- Only the acreage experiencing one or more of the following impacts were included in the nominated amount: moderate to heavy key pest pressure, regulatory impacts, and unsuitable terrain.

TABLE A.2: 2006 SECTOR NOMINATION FOR ORCHARD REPLANT*

2006 (Sector) Nomination		California Grape and Tree Fruit League—Stone Fruit	California Grape and Tree Fruit League—Raisin & Table Grapes	California Walnut Commission	Almond Hullers & Processors Association
Applicant Request for 2006	Requested Hectares (ha)	2,131	433	809	486
	Requested Application Rate [Active Ingredient] (kg/ha)	336 (bed =65% of ha)	382	280	364 (bed =65% of ha)
	Requested Kilograms (kg)	716,449	165,561	226,796	176,901
CUE Nominated for 2006	Nominated Hectares (ha)	1,645	221	477	355
	Nominated Application Rate (kg/ha)	336	357	200	364
	Nominated Kilograms (kg)	553,098	78,944	95,525	129,491

2006 Sector Nomination Totals	Overall Reduction (%)	33%
	2006 U.S. CUE Nomination	859,758
	Research Amount (kg)	1658
	Total 2006 U.S. Sector Nominated Kilograms (kg)	**859,923**

* See Appendix A for complete description of how the nominated amount was calculated.

California Grape and Tree Fruit League—Stone Fruit - Part B: Crop Characteristics and Methyl Bromide Use

California Grape and Tree Fruit League—Stone Fruit 10. Key Diseases and Weeds for which Methyl Bromide Is Requested and Specific Reasons for this Request

California Grape and Tree Fruit League—Stone Fruit. Table 10.1: Key Diseases and Weeds and Reason for Methyl Bromide Request

Region where Methyl Bromide Use is Requested	Key Pests	Specific Reasons why Methyl Bromide is Needed
California Grape and Tree Fruit League—Stone Fruit	Replant problem is a disease complex comprised of interactions between various pathogens and environmental factors. **Nematodes (Primary pests):** *Meloidogyne* (root knot); *Criconemella* (ring); *Xiphinema* (dagger); *Pratylenchus* (root lesion); and *Tylenchulus* (citrus) **Pathogens:** *Armellaria*, *Phytophthora*, and various fungi, depending on orchard location and conditions that are thought to contribute to orchard replant disorder. **Insect:** *Pollyphylla decemlineata* (tenlined June beetle)	Some alternatives, such as 1,3-D, may be effective in reducing the effects of orchard replant disorder where there are no legal restriction and in light, sandy loam soils, and where there is acceptable soil moisture. In other situations, where soils are medium to heavy, or where township caps are applicable, MB is the only compound that can effectively target root remnants from previous orchard trees.

California Grape and Tree Fruit League—Stone Fruit. 11. (*i*) Characteristics of Cropping System and Climate

The typical practice of replanting orchards with MB is to remove the old trees after the final harvest (typically 20-25 years after planting). The soil is harrowed and the remaining roots are removed. The soil is fumigated in the late fall and the trees are replanted in the early winter. When using MB growers have traditionally not needed to leave a fallow period between tree removal and the replanting of the new trees.

The typical practice of replanting orchards with 1,3-D + chloropicrin (the best alternative where conditions permit), is to remove the old trees after harvest and as many of the roots as time and resources permit. After the removal of the old trees the soil is ripped and then irrigated to allow the soil to settle. Any roots that are pulled to the surface are removed, and the soil is graded. Due to the late harvest of the stone fruit crops there is not generally a fallow period between the removal of the old trees and replanting with new trees.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	California Grape and Tree Fruit League—Stone Fruit
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	stone fruit trees for production
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	perennial (20-25 years)
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	none
SOIL TYPES: *(Sand, loam, clay, etc.)*	varied (light, medium, heavy)
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	once in life of orchard (20-25 years), until replant with new orchard
OTHER RELEVANT FACTORS:	None identified

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA plant hardiness zones 9a, 9b											
RAINFALL *(mm)*	16	72.1	17.3	0	trace	1.0	trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)*	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE	1st year, land preparation and fumigation; no additional fumigation for life of orchard (~20 years)											
PLANTING SCHEDULE	occurs 2nd year, after fumigation											
KEY MARKET WINDOW:	Not applicable											

*For Fresno, California.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Orchard replant into previously planted orchard land (the typical situation in California) requires reducing pathogen populations (mostly nematodes and fungi) and nutrient sources of previous orchard tree roots and root remnants. This requires an effective material that is volatile and can penetrate into the soil to reach these plant materials. In sandy, loam soils, where restrictions do not apply, 1,3-D may be an acceptable alternative that can penetrate to the target areas. In other situations, this compound and other alternatives are not able to move sufficiently through the soil to remove the problem pests. Thus, there is a critical need for MB not only for the stone fruit consortium, but for other consortia of this sector. The infrequent use of MB (once in 25-40 years) and the positive benefits of vigorous early tree growth make MB a key component of orchard fruit and nut production.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
AREA TREATED *(hectares)*	3,435	2,815	3,522	1,723	1,063	not available
RATIO OF FLAT FUMIGATION [a] METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	not available
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	1,115,189	946,612	1,184,391	579,254	357,558	not available
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	98:2	98:2	98:2	98:2	98:2	not available
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	shank injected	shank injected	shank injected	shank injected	shank injected	not available
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha*)	336	336	336	336	336	not available
APPLICATION RATE [FORMULATION] (kg/ha*)	343	343	343	343	343	not available
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	34.3	34.3	34.3	34.3	34.3	not available

** For Flat Fumigation treatment application rate and dosage rate may be the same.*

[a] Various methods are used depending on the particular nursery, fumigation can be Flat Fumigation, strip, or even "by the hole" (for individual tree replacement; MB is the only product that has acceptable technology for hole application—approximately 0.5 kg/tree).

California Grape and Tree Fruit League—Stone Fruit. Part C: Technical Validation

California Grape and Tree Fruit League—Stone Fruit. 13. Reason for Alternatives Not Being Feasible

California Grape and Tree Fruit League—Stone Fruit. Table 13.1: Reason for Alternatives Not Being Feasible

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Chemical Alternatives		
chloropicrin	has some activity as fungicide and may be useful if fungi are significant causal agents of replant disorder (Trout et al., 2002); will not reduce nematodes significantly and they are major cause of replant disorder; may have phytotoxicity problems at rates that are effective against pests (Browne et al., 2002a)	no
1,3-dichloropropene (1,3-D)	Most orchards fall in areas with township cap restrictions on use of 1,3-D. May be effective where township caps do not apply and where soil moisture and texture are such that 1,3-D can penetrate to remnant tree roots of previous orchard. Where legal restrictions are in place and/or where soils are medium to heavy, 1,3-D is not effective to control nematodes associated with replant disorder.	only with light soils, if no legal restrictions apply
metam-sodium	May be effective in killing root tissue near soil surface, but will not kill roots below 75 mm when metam-sodium is applied at label rates; not an effective nematicide since it can not reach deep areas of soil, which is the primary cause of orchard replant problems; generally not effective in areas where water percolation is a problem (e.g., clay soils). However, in the future, new delivery systems could increase effectiveness of this compound to make it a more acceptable alternative to MB (where soil conditions are amenable to its use). Reducing time in which material can diffuse throughout target area will improve efficacy (McKenry, 1999) ; generally not effective in areas where water percolation is a problem (e.g., clay soils).	no
dazomet	This alternative has been examined by researchers and is inconsistent in field trials. This has been deemed not feasible due to lack of performance in field trials and inability to penetrate and kill nematodes at depths required for orchard replant acceptability. This product requires that there be uniform saturation of the granules to ensure that the product will perform consistently. This is not feasible in a typical orchard situation. This product "…will not be successful until more is known about the dissolution rate of the granules" (McKenry, 1999).	no
nematicides	Other nematicides (besides 1,3-D) have limited use due to their lack of performance or due to regulatory issues. Therefore, this product was deemed not feasible	no

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
NON CHEMICAL ALTERNATIVES		
fallow	not sufficient alone; frequently done for 1 year regardless of fumigant that follows; may require 4-10 year fallow for some crops (McKenry, 1999) and may not be sufficient even then; may provide partial control in some crops, however, economically difficult for grower to sustain (Browne et al., 2002b; Trout et al., 2002)	no
rootstock	Genetic factors are known that confer some tolerance for orchard replant problems—for example, in one study an orchard with Marianna 2624 Plum rootstock was not as sensitive as an orchard with Nemaguard peach rootstock (McKenry, 1999). This is in spite of the resistance of Nemaguard to reproduction of root knot nematodes—however, feeding on Nemaguard roots were aided by reproduction on remnant roots causing significant replant problem. Rootstock for all of the commodities in this sector are subject to differential effects from soil and other environmental factors, as well as the array of pests that comprise individual orchards. Consequently, rootstock can only be considered a component of an overall orchard management plan, and not a solution to the replant problem.	no
biofumigation, solarization, steam, biological control, cover crops and mulching, Crop rotation / fallow, crop residue and compost, substrate/plug plants, plowing/tillage, resistant cultivars, grafting/resistant rootstock, physical removal, organic amendments/compost, general IPM	Each of the not in kind alternatives were listed as options for replacement of MB. Many of these alternatives are currently being employed with current replant practices. Alternatives such as biofumigation, solarization, and steam are not feasible due to planting times, one time fumigation requirement per orchard (steam treatment), or inability to attain sufficient biomass of plant material (biofumigation). Biological control may have promise but research has not identified agents that can be used on a commercial scale or that work consistently well. The University of California is investigating biological control of major fungal pathogens, but this work is still in the early stages of research. As such, MB is currently considered critical to the industry.	no
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin	May be effective where township caps do not apply and where soil moisture and texture are such that 1,3-D can penetrate to remnant tree roots of previous orchard. Where legal restrictions are in place and/or where soils are medium to heavy, 1,3-D is not effective to control nematodes associated with replant disorder.	only with light soils, if no legal restrictions apply

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
1,3-D + metam-sodium	May be effective where township caps do not apply and where soil moisture and texture are such that 1,3-D can penetrate to remnant tree roots of previous orchard. Where legal restrictions are in place and/or where soils are medium to heavy, 1,3-D is not effective to control nematodes associated with replant disorder. If soils are amenable, 1,3-D may be applied followed by a sprinkler application of metam-sodium. This may be effective if the irrigation system is economically feasible and if land preparation is of sufficient quality to expose targeted old tree roots to the chemicals.	only with light soils, if no legal restrictions apply

** Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.*

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE – STONE FRUIT. 14. LIST AND DISCUSS WHY REGISTERED *(and Potential)* PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE:

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE – STONE FRUIT. TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
herbicides (e.g., triclopyr, glyphosate)	Not acceptable treatment alone. Herbicides are used for killing remnant roots of previous orchard plants; research with walnuts (McKenry, 1999) suggested that herbicide treatment followed by 18 months fallow can result in root knot nematode control of 97% compared to untreated plots. However, this effect only lasted 6 months, not long enough to achieve acceptable establishment of new orchard; no herbicides were found that kill grape roots (McKenry, 1999). In stone fruit, while remnant roots were killed after 18 months, endoparasitic nematodes were not significantly reduced (McKenry et al., 1995). The combination of herbicide costs plus additional 18 months waiting period prior to planting, becomes an economic burden, especially with the limited effectiveness of treatment.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
sodium azide	not registered in U.S., no registration package has been submitted	No	unknown
propargyl bromide	not registered in U.S., no registration package has been submitted	No	unknown
iodomethane	not registered in U.S.	Yes	unknown

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – REPLANT DISORDER

KEY PEST: REPLANT DISORDER	AVERAGE DISEASE % OR RATING AND YIELDS IN PAST 3~5 YEARS				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF TRIALS	DISEASE (% OR RATING)	# OF TRIALS	ACTUAL YIELDS (T/HA)	CITATION
[1] MB (400 kg/ha) [2] 1,3-D (350 kg/ha) + metam-sodium (125 kg/ha) [3] 1 year fallow (non-fumigated) [4] non-fumigated	Peach, fumigation Fall, 1997; Replant, Spring, 1998; 4 reps, **research plots**	**Trunk diameter** (mm for MB trt; and % of MB value); Aug. 2002: [1] 114a [2] 92%ab [3] 86%bc [4] 81%c	same	**Market Yield** (kg/tree MB trt; and % of MB value); Aug. 2002: [1] 38a [2] 100%a [3] 93%a [4] 86%a	Trout et al., 2002
[1] MB (400 kg/ha) [2] 1,3-D (260 kg/ha) + chloropicrin (150 kg/ha) + metam-sodium (63 kg/ha) [3] 1 year fallow (non-fumigated) [4] non-fumigated	Peach, fumigation Fall, 1998; Replant, Spring, 1999; 4 reps, **research plots**	**Trunk diameter** (mm for MB trt; and % of MB value); Aug. 2002: [1] 94.1a [2] 102%a [3] 89%b [4] 82%b	same	**Market Yield** (kg/tree MB trt; and % of MB value); July, 2002: [1] 30ab [2] 109%a [3] 87%bc [4] 75%c	Trout et al., 2002

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

***No** alternatives are feasible in the majority of orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). Listed below are alternatives for sites where soils are amenable to 1,3-D and where township caps are not applicable.*

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D (385 kg/ha)	nematodes, roots	0-20% (based on research plots)	10% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha) + metam-sodium (65 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (350 kg/ha) + metam-sodium (125 kg/ha)	nematodes, roots	0-10% (based on research plots)	5% (based on research plots)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			See discussion above

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

In situations with light soil, and water available to moisten the top 30 cm of soil, 1,3-D with chloropicrin or metam-sodium can be effective treatments for orchard replant problems. However, in medium or heavy soils, high moisture content below 1 to 1.5 meters usually reduces the efficacy of 1,3-D and precludes its use. MB is therefore critical since no other treatment has been proven to exhibit such a positive effect on achieving a healthy orchard for 20-25 years of production. Alternatives that are being investigated include fallowing studies (frequently with prior treatment with an herbicide to kill remnant roots from previous plantings). Thus far, nematode control is short-lived (only up to 6 to 9 months) (6). Rootstock with resistance to the primary nematode pests are being developed, but orchard replant disorder is caused by varying factors that are different in different orchard locations and according to the crop grown (and crop grown prior to the orchard replant).

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?

Tests are being conducted to develop new delivery systems to target pests with alternatives such as metam-sodium and 1,3-D to depths where these compounds can more efficiently kill roots and nematodes that feed on roots. McKenry (1999) outlines several approaches through field research studies that can help address MB alternatives for stone fruit, as well as walnuts, grapes, and almonds. These include use (combinations) of herbicides to kill remnant roots, use of fallow, use of "virgin" soil as an amendment to possibly reduce replant problem, resistant rootstocks when available, irrigation regimes to improve consistency of metam-sodium, etc. Field studies on these perennial crops require considerable time to conduct and until replicated trials can be analyzed MB is required.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—STONE FRUIT. SUMMARY OF TECHNICAL FEASIBILITY

No alternatives are feasible in the majority of stone fruit orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). Orchard replant problems for all orchard replant sites are a result of biological and environmental causes, and interactions of these forces. Studies of individual pest populations tell only a small portion of the story of replant complex, since individual pests cause only a portion of the adverse growth effects. Nevertheless, *Criconemella xenoplax* infests at least 60% of hectares planted in cling peaches (McKenry, 1999). An additional 35% of fresh peach, plum, and nectarine plantings are infested with *P. vulnus* and a somewhat smaller area is infested with *C. xenoplax*. As such, it is clear that the long life of orchards requires that optimal pest management strategies be employed to overcome replant disorder during the one opportunity available—at orchard establishment. The long history of 1,3-D use in California suggests that at optimal conditions it (or in combination with another chemical) is the best alternative to MB. However, the reality of California orchard and vineyard locations precludes the majority of growers taking advantage of the material since either township caps or soil texture/moisture issues reduce efficacy or legal availability to 1,3-D. Therefore, for the near future, for the orchard and vineyard sector in California, MB is critical to the efficient management of many of these commercial orchards.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 10.1: KEY DISEASES AND WEEDS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE	KEY PESTS	SPECIFIC REASONS WHY METHYL BROMIDE IS

METHYL BROMIDE USE IS REQUESTED		NEEDED *(e.g. Effective herbicide available, but not registered for this crop; mandatory requirement to meet certification for disease tolerance)*
California Grape and Tree Fruit League—Raisin & Table Grapes	Replant problem is a disease complex comprised of interactions between various pathogens and environmental factors. **Nematodes (Primary pests):** *Meloidogyne* (root knot); *Criconemella* (ring); *Xiphinema* (dagger); *Pratylenchus* (root lesion); and *Tylenchulus* (citrus) **Pathogens:** *Armellaria*, *Phytophthora*, and various fungi, depending on orchard location and conditions, that are thought to contribute to orchard replant disorder. **Insect:** At some sites *Pollyphylla decemlineata* (tenlined June beetle)	Some alternatives, such as 1,3-D, may be effective in reducing the effects of orchard replant disorder where there are no legal restriction and in light, sandy loam soils,. In other situations, where soils are medium to heavy, or where township caps are applicable, MB is the only compound that can reach targeted root remnants from previous orchard trees.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

As in stone fruit orchards, the typical practice of replanting vineyards with MB is to remove the old plantings after the final harvest (typically 20-25 years after planting). The soil is harrowed and the remaining roots are removed. The soil is fumigated in the late fall and the trees are replanted in the early winter. When using MB growers have traditionally not needed to leave a fallow period between tree removal and the replanting of the new trees.

The typical practice of replanting with 1,3-D + chloropicrin (the best alternative where conditions permit), is to remove the old plants after harvest and as many of the roots as time and resources permit. After the removal of the old plants the soil is ripped and then irrigated to allow the soil to settle. Any roots that are pulled to the surface are removed, and the soil is graded.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	CALIFORNIA GRAPE AND TREE FRUIT LEAGUE – RAISIN & TABLE GRAPES
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	raisins and table grapes
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	perennial (average of 22 year vineyard life)
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	none
SOIL TYPES: *(Sand, loam, clay, etc.)*	light
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	once in 22 years
OTHER RELEVANT FACTORS:	The applicant did not identify any other relevant factors.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA plant hardiness zones 9a, 9b											
RAINFALL *(mm):*30-60 CM/YR	16	72.1	17.3	0	trace	1.0	trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)*	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE	1st year, land preparation and fumigation; no additional fumigation for life of orchard (~22 years)											
PLANTING SCHEDULE	occurs 2nd year, after fumigation											
KEY MARKET WINDOW:	Not applicable											

*For Fresno, California

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Replanting vineyards into non-virgin areas (the typical situation in California) requires removing pathogens (nematodes and fungi) and nutrient sources of previous orchard tree roots and root remnants. This requires an effective material that is volatile and can penetrate into the soil to reach these plant materials. In sandy, loam soils, where restrictions do not apply, 1,3-D may be an acceptable alternative that can penetrate to the target areas. However, in vineyard regions of California, township caps may reduce use of 1,3-D to a fraction of planted vineyard replant situations.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
AREA TREATED *(hectares)*	729	316	251	273	67	not available
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat Fumigation	not available
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	262,684	124,210	108,035	70,732	18,248	not available
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	98:2	98:2	98:2	98:2	98:2	not available
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	shank injected	shank injected	shank injected	shank injected	shank injected	not available
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha*)	361	393	430	259	271	not available

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
APPLICATION RATE [FORMULATION] (kg/ha*)	368	401	439	264	277	not available
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m²)**	36,8	40.1	43.9	26.4	27.7	Not available

** For Flat Fumigation treatment application rate and dosage rate may be the same.*

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. PART C: TECHNICAL VALIDATION

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

(Give list of all relevant chemical and non chemical alternatives, and their combinations)

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-D	Where soil moisture is acceptable and township caps are not instituted, 1,3-D may provide sufficient management of replant disorder in vineyards with light soils.	only with light soils, if no legal restrictions apply
metam-sodium	not an effective nematicide since it can not reach deep areas of soil, which is the primary cause of orchard replant problems; generally not effective in areas where water percolation is a problem (e.g., clay soils); nematodes are the primary pest in the replant disorder complex; generally not effective in areas where water percolation is a problem (e.g., clay soils).	no
chloropicrin	where fungi are primary pest (requires addition of 1,3-D is nematodes are present)	no
dazomet	This alternative has not been examined by researchers for vineyards, however, it is likely that problems with this chemical are similar to the stone fruit industry—i.e., it is likely similar to metam-sodium in that it would not penetrate and kill nematodes at depths required for orchard replant acceptability. This product requires that there be uniform saturation of the granules to ensure that the product will perform consistently. This likely would not be feasible in a typical vineyard situation.	no
nematicides	Other nematicides (besides 1,3-D) have limited use due to their lack of performance or due to regulatory issues. Therefore, this product was deemed not feasible	no

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
sodium tetrathiocarbonate	This compound does not penetrate the old roots of the previous vineyard. By this chemical not penetrating the old roots it then can be a source of inoculum for various fungal and nematodes pests. Therefore, the use of this product alone will not provide adequate control of the pest complex in vineyards. This product is being used by some of the growers but not as a replacement of MB but instead as a means to maintain population levels. Generally this product is used in combination with other practices that will allow for successful replanting.	no
NON CHEMICAL ALTERNATIVES		
fallow	not sufficient alone; frequently done for 1 year regardless of fumigant that follows; may require 4-10 year fallow for some crops (6) and may not be sufficient even then, especially if vineyard viruses, such as grape fan leaf virus (GFLV) have occurred; may provide partial control in some crops (2,11), however, economically difficult for grower to sustain (2,11)	no
rootstock	available with resistance to some problem nematode species, but no multiple resistance;	no
biofumigation, solarization, steam, biological control, cover crops and mulching, crop rotation / fallow, crop residue and compost, substrate/plug plants, plowing/tillage, resistant cultivars, grafting/resistant rootstock, physical removal, organic amendments/compost, general IPM	Each of the not in kind alternatives were listed as options for replacement of MB. Many of these alternatives are currently being employed with current replant practices (Schneider et al., 2000). IPM approaches are being extensively investigated (Schneider et al., 1999). Alternatives such as biofumigation, solarization, and steam are not feasible due to planting times, one time fumigation requirement per orchard (steam treatment), or inability to attain sufficient biomass of plant material (biofumigation). Development of durable resistance to nematodes in grape rootstock is an ongoing and challenging area of research (Ferris and Walker, 2002). Biological control may have promise but research has not identified agents that can be used on a commercial scale or that work consistently well. The University of California is investigating biological control of major fungal pathogens, but this work is still in the early stages of research. As such, MB is currently considered critical to the industry.	no

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin	May be effective where township caps do not apply and where soil moisture and texture are such that 1,3-D can penetrate to remnant tree roots of previous vineyard. Where legal restrictions are in place and/or where soils are medium to heavy, 1,3-D is not effective to control nematodes associated with replant disorder.	only with light soils, if no legal restrictions apply
1,3-D + metam-sodium	May be effective where township caps do not apply and where soil moisture and texture are such that 1,3-D can penetrate to remnant tree roots of previous orchard. Where legal restrictions are in place and/or where soils are medium to heavy, 1,3-D is not effective to control nematodes associated with replant disorder. If soils are amenable, 1,3-D may be applied followed by a sprinkler application of metam-sodium. This may be effective if the irrigation system is economically feasible and if land preparation is of sufficient quality to expose targeted old tree roots to the chemicals.	only with light soils, if no legal restrictions apply

** Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.*

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE – RAISIN & TABLE GRAPES. 14. LIST AND DISCUSS WHY REGISTERED *(and Potential)* PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE:

MBTOC-listed alternatives were addressed in Section 13. No other alternatives were considered feasible.

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
sodium azide	not registered in U.S., no registration package has been received	No	unknown
propargyl bromide	not registered in U.S., no registration package has been received	No	unknown
iodomethane	not registered in U.S.	Yes	unknown

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED: *(Use same groups as in Question 10 and provide a separate table for each target group for which methyl bromide is considered essential. Omit pathogen and/or weed tables if these are not the reason why critical use is requested.)*

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – REPLANT DISORDER (NEMATODES).

KEY PEST: REPLANT DISORDER (NEMATODES)					
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	**# OF TRIALS**	**DISEASE (% OR RATING)**			**CITATION**
[1] not fumigated [2] MB (455 kg/ha) [shanked, tarp] [3] metam-sodium (125 kg/ha) [microspray] [4] InLine + metam-sodium (125 kg/ha) [microspray] [5] chloropicrin (455 kg/ha) [drip] + metam-sodium (125 kg/ha) [microspray]	5 reps; grapes	*Meloidogyne* spp. (#/100 cc soil) (trial planted and sampled 2001) [1] 324a [2] 0c [3]290a [4] 0c [5] 8b	*Tylenchulus semipenetrans* (#/100 cc soil) (trial planted and sampled 2001) [1] 121a [2] 0c [3] 157a [4] 0c [5] 2bc		Schneider et al., 2002
[1] not fumigated [2] 1-year fallow [3] 1-year fallow + cover crop [4] MB (455 kg/ha) [shanked, tarp] [5] 1,3-D (352 kg/ha) [in 60 mm water] + metam-sodium (125 kg/ha) [microspray] [6] 1,3-D (352 kg/ha) [in 100 mm water] + metam-sodium (125 kg/ha) [microspray]	5 reps; grapes	*Meloidogyne* spp. per 100 cc soil (trial planted 1998, sampled 2001)			Schneider et al., 2002
		Thompson seedless rootstock	Teleki 5C rootstock	Harmony rootstock	
		[1] 144ab [2] 215a [3] 145ab [4] 1def [5] 0.2ef [6] 6cde	[1] 261a [2] 49b [3] 190a [4] 0.3c [5] 0.6c [6] 0.2c	[1] 0.8a [2] 0.0a [3] 0.1a [4] 0.0a [5] 0.0a [6] 0.0a	
[1] not fumigated [2] 1-year fallow [3] 1-year fallow + cover crop [4] MB (455 kg/ha) [shanked, tarp] [5] 1,3-D (352 kg/ha) [in 60 mm water] + metam-sodium (125 kg/ha)	5 reps; grapes	*Tylenchulus semipenetrans* per 100 cc soil (trial planted 1998, sampled 2001)			Schneider et al., 2002
		Thompson seedless rootstock	Teleki 5C rootstock	Harmony rootstock	

KEY PEST: REPLANT DISORDER (NEMATODES)					
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	**# OF TRIALS**	**DISEASE (% OR RATING)**			**CITATION**
[microspray] [6] 1,3-D (352 kg/ha) [in 100 mm water] + metam-sodium (125 kg/ha) [microspray]		[1] 638a [2] 352a [3] 463a [4] 0.4c [5] 3c [6] 6b	[1] 301a [2] 434a [3] 342a [4] 4b [5] 1b [6] 3b	[1] 913a [2] 1123a [3] 723a [4] 2b [5] 6b [6] 7b	

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE—RAISIN & TABLE GRAPES. TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

***No** alternatives are feasible in the majority of orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). Listed below are alternatives for sites where soils are amenable to 1,3-D and where township caps are not applicable.*

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D (385 kg/ha)	nematodes, roots	0-20% (based on research plots)	10% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha) + metam-sodium (65 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (350 kg/ha) + metam-sodium (125 kg/ha)	nematodes, roots	0-10% (based on research plots)	5% (based on research plots)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			See discussion above

California Grape and Tree Fruit League—Raisin & Table Grapes. 17. Are There Any Other Potential Alternatives Under Development which Are Being Considered to Replace Methyl Bromide?

In situations with light soil, and water available to moisten the top 30 cm of soil, 1,3-D with chloropicrin or metam-sodium can be effective treatments for replant problems. However, in medium or heavy soils, high moisture content below 1 to 1.5 meters usually reduces the efficacy of 1,3-D and precludes its use. MB is therefore critical since no other treatment has been proven to exhibit such a positive effect on achieving a healthy vineyard for 20-25 years of production. Alternatives that are being investigated include fallowing studies (frequently with prior treatment with an herbicide to kill remnant roots from previous plantings). Thus far, nematode control is short-lived (only up to 6 to 9 months) (6). Rootstock with resistance to the primary nematode pests are being developed, but orchard replant disorder is caused by varying factors that are different in different orchard locations and according to the crop grown (and crop grown prior to the orchard replant).

California Grape and Tree Fruit League—Raisin & Table Grapes. 18. Are There Technologies Being Used to Produce the Crop which Avoid the Need for Methyl Bromide?

Tests are being conducted to develop new delivery systems to target pests with alternatives such as metam-sodium and 1,3-D to depths where these compounds can more efficiently kill remnant roots and nematodes that feed on roots (e.g., Martin, 2003; McKenry, 2001). McKenry (1999) outlines several approaches through field studies that can address MB alternatives for walnuts, grapes, stone fruit, and almonds. These include use (combinations) of herbicides to kill remnant roots, use of fallow, use of “virgin” soil as an amendment to possibly reduce replant problem, resistant rootstocks when available, irrigation regimes to improve consistency of metam-sodium, etc. Field studies on these perennial crops require considerable time to conduct and until replicated trials can be analyzed MB is required.

California Grape and Tree Fruit League—Raisin & Table Grapes. Summary of Technical Feasibility

No alternatives are feasible in the majority of vineyard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of vines are likely to be greater than 20% (McKenry, 1999). As with all orchard replant sites, orchard replant problems for vineyards are a result of biological and environmental causes, and probably interactions of these forces. Studies of individual pest populations tell only a small portion of the story of replant complex, since individual pests cause only a portion of the adverse growth effects. It is clear that the long life of vineyards requires that optimal pest management strategies be employed to overcome replant disorder during the one opportunity available—at time of establishment. The long history of 1,3-D use in California suggests that at optimal conditions it (or in combination with another chemical) is the best alternative to MB. However, the reality of California orchard and vineyard locations precludes the majority of growers taking advantage of the material since either township caps or soil texture/moisture issues reduce efficacy or legal availability to 1,3-D. Therefore, for the near future, for the orchard and vineyard sector in California, MB is critical to the efficient management of many of these commercial operations.

California Walnut Commission. Part B: Crop Characteristics and Methyl Bromide Use

California Walnut Commission. 10. Key Diseases and Weeds for which Methyl Bromide Is Requested and Specific Reasons for this Request

California Walnut Commission. Table 10.1: Key Diseases and Weeds and Reason for Methyl Bromide Request

Region where methyl bromide use is requested	Key pests	Specific reasons why methyl bromide is needed
California Walnut Commission (Central Valley and coastal valleys)	Replant problem caused by interactions of pests and environment primarily **Nematodes:** (in ~85% of orchards) *Pratylenchus vulnus*, *Mesocriconema xenoplax*, *Meloidogyne* spp.	Township caps and unacceptable soil moisture (>12% at over 1 meter depths in medium and heavy soils) limit 1,3-D use (the best alternative) to approximately only 30% of orchard land.

CALIFORNIA WALNUT COMMISSION. 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

The typical practice of replanting orchards with MB is to remove the old trees after the final harvest (typically 30-40 years—and sometimes longer—after planting). The soil is harrowed and the remaining roots are removed. The soil is fumigated in the late fall and the trees are replanted in the early winter. When using MB growers have traditionally not needed to leave a fallow period between tree removal and the replanting of the new trees.

The typical practice of replanting orchards with 1,3-D + chloropicrin (the best alternative where conditions permit), is to remove the old trees after harvest and as many of the roots as time and resources permit. After the removal of the old trees the soil is ripped and then irrigated to allow the soil to settle. Any roots that are pulled to the surface are removed, and the soil is graded.

CALIFORNIA WALNUT COMMISSION. TABLE. 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	REGION B
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	English walnuts on black/Paradox rootstocks
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	perennial
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	none
SOIL TYPES: *(Sand, loam, clay, etc.)*	light (30%), medium (40%), heavy (30%)
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	once in orchard life (up to 40 years)
OTHER RELEVANT FACTORS:	No other relevant factors were identified by the applicant.

CALIFORNIA WALNUT COMMISSION. TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA plant hardiness zones 9a, 9b											
RAINFALL *(mm):*30-60 CM/YR	16	72.1	17.3	0	trace	1.0	trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)*	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE	1st year, land preparation and fumigation; no additional fumigation for life of orchard (~40 years)											
PLANTING SCHEDULE	occurs 2nd year, after fumigation											
KEY MARKET WINDOW:	Not applicable											

* For Fresno, California

California Walnut Commission. 11. (*ii*) Indicate if any of the above characteristics in 11. (*i*) prevent the uptake of any relevant alternatives?

In approximately 70% of walnut orchard situations (Central Valley and coastal valleys in California) surface soil moisture and restrictions due to township caps, make the best alternative, 1,3-D, unlikely to be able to replace MB in the short term.

California Walnut Commission. 12. Historic Pattern of Use of Methyl Bromide, and/or Mixtures Containing Methyl Bromide, for which an Exemption Is Requested

California Walnut Commission. Table 12.1 Historic Pattern of Use of Methyl Bromide

For as many years as possible as shown specify:	1997	1998	1999	2000	2001	2002
Area Treated *(hectares)*	344	249	348	89	1,393	No data
Ratio of Flat Fumigation methyl bromide use to strip/bed use if strip treatment is used	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat fumigation
Amount of methyl bromide active ingredient used *(total kg)*	153,721	111,518	156,162	39,687	24,308	No data
Formulations of methyl bromide (*methyl bromide /chloropicrin)*	98/2	98/2	98/2	98/2	98/2	98/2
Method by which methyl bromide applied *(e.g. injected at 25cm depth, hot gas)*	shank injected	shank injected	shank injected	shank injected	shank injected	shank injected
Application rate [Active Ingredient] (kg/ha*)	447	448	448	448	220	No data
Application rate [Formulation] (kg/ha*)	456	456	456	456	225	230

ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	45.6	45.6	45.6	45.6	22.5	23

** For Flat Fumigation treatment application rate and dosage rate may be the same.*

CALIFORNIA WALNUT COMMISSION. PART C: TECHNICAL VALIDATION

CALIFORNIA WALNUT COMMISSION. 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

CALIFORNIA WALNUT COMMISSION. TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-D	With appropriate soil type and moisture conditions, an effective nematicide, usually more effective for orchard replant problems with chloropicrin for added fungicidal activity; also is relatively effective in killing remnant roots from previous orchard planting; however, subject to strict township caps and specific moisture requirements.	only with light soils, if no legal restrictions apply
chloropicrin	May perform acceptably alone when fungi are primary cause of orchard replant problem; for nematode causation, presence of 1,3-D is necessary.	no
metam-sodium	not an effective nematicide since it can not reach deep areas of soil, which is the primary cause of orchard replant problems; generally not effective in areas where water percolation is a problem (e.g., clay soils); however, can sometimes kill remnant tree roots that harbor nematodes, but legal label rates (363 kg/ha) generally can only kill roots above the surface 75 cm (McKenry, 1999); below this level, nematodes populations survived. generally not effective in areas where water percolation is a problem (e.g., clay soils).	no
dazomet	This alternative has been examined by researchers and is inconsistent in field trials. This has been deemed not feasible due to lack of performance in field trials and inability to penetrate and kill nematodes at depths required for orchard replant acceptability. This product requires that there be uniform saturation of the granules to ensure that the product will perform consistently. This is not feasible in a typical orchard situation.	no
nematicides	Other nematicides (besides 1,3-D) have limited use due to their lack of performance or due to regulatory issues. Therefore, this product was deemed not feasible	no

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
NON CHEMICAL ALTERNATIVES		
fallow	not sufficient alone; frequently done for 1 year regardless of fumigant that follows; may require 4-10 year fallow for some crops (McKenry, 1999); may provide partial control in some crops, however, economically difficult for grower to sustain (Browne et al., 2002b; Trout et al., 2002); might be used following herbicide treatment but is additional expense for reduced efficacy compared to more effective fumigants.	no
resistant rootstock	no commercially acceptable rootstocks that have resistance (McKenry, 1999)	no
biofumigation, solarization, steam, biological control, cover crops and mulching, crop rotation / fallow, crop residue and compost, substrate/plug plants, plowing/tillage, resistant cultivars, grafting/resistant rootstock, physical removal, organic amendments/compost, general IPM	Each of the not in kind alternatives were listed as options for replacement of MB. Many of these alternatives are currently being employed with current replant practices. Alternatives such as biofumigation, solarization, and steam are not feasible due to planting times, one time fumigation requirement per orchard (steam treatment), or inability to attain sufficient biomass of plant material (biofumigation). Biological control may have promise but research has not identified agents that can be used on a commercial scale or that work consistently well. The University of California is investigating biological control of major fungal pathogens, but this work is still in the early stages of research. As such, MB is currently considered critical to the industry	no

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin	1,3-D mixtures can be effective in light soils in areas with no legal restrictions [in walnuts, probably only 30% of orchard replant situations (McKenry, 1999)]; or situations where moisture levels are acceptable (requires less that 12% at depths of up to 1.5 meters, and sufficient moisture at surface to disperse compounds, while reducing emissions); restrictions reduce orchard sites where 1,3-D is feasible option; in heavy soils 1,3-D is not a feasible alternative	only with light soils, if no legal restrictions apply
1,3-D + metam-sodium		only with light soils, if no legal restrictions apply
1,3-D + chloropicrin + metam-sodium		only with light soils, if no legal restrictions apply

** Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.*

CALIFORNIA WALNUT COMMISSION. 14. LIST AND DISCUSS WHY REGISTERED *(and Potential)* PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE:

CALIFORNIA WALNUT COMMISSION REGION C. TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
herbicides (e.g., triclopyr, glyphosate)	Not acceptable treatment alone. Herbicides are used for killing remnant roots of previous orchard plants; research with walnuts (McKenry, 1999) suggested that herbicide treatment followed by 18 months fallow can result in root knot nematode control of 97% compared to untreated plots. However, this effect only lasted 6 months, not long enough to achieve acceptable establishment of new orchard; no herbicides were found that kill grape roots (McKenry, 1999). In stone fruit, while remnant roots were killed after 18 months, endoparasitic nematodes were not significantly reduced (McKenry et al., 1995). The combination of herbicide costs plus additional 18 months waiting period prior to planting, becomes an economic burden, especially with the limited effectiveness of treatment.

CALIFORNIA WALNUT COMMISSION. 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

CALIFORNIA WALNUT COMMISSION. TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
sodium azide	not registered in U.S., no registration package has been received	No	unknown
propargyl bromide	not registered in U.S., no registration package has been received	No	unknown
iodomethane	not registered in U.S.	Yes	unknown

CALIFORNIA WALNUT COMMISSION. 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED

CALIFORNIA WALNUT COMMISSION. TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – KEY PEST 1: NEMATODES.

KEY PEST: REPLANT DISORDER	AVERAGE DISEASE % OR RATING AND YIELDS IN PAST 3~5 YEARS				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	# OF TRIALS	DISEASE (% OR RATING)	# OF TRIALS	ACTUAL YIELDS (T/HA)	CITATION
see Table 16.1 for Regions A (Stone Fruit), B (Grapes), & D (Almonds)					

CALIFORNIA WALNUT COMMISSION. TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

***No** alternatives are feasible in the majority of orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). Listed below are alternatives for sites where soils are amenable to 1,3-D and where township caps are not applicable.*

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D (385 kg/ha)	nematodes, roots	0-20% (based on research plots)	10% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha) + metam-sodium (65 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (350 kg/ha) + metam-sodium (125 kg/ha)	nematodes, roots	0-10% (based on research plots)	5% (based on research plots)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			See discussion above

CALIFORNIA WALNUT COMMISSION. 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?: *(If so, please specify.)*

According to the consortium, in 2001 MB was used on 21,316 hectares (only about 1/3 of the area is actually treated in strip applications). In the same year, 1,3-D was applied to 113 hectares and metam-sodium was applied to 28 hectares. The limited (although increasing) use of the best alternative1,3-D, is primarily due to township caps in the concentrated areas of walnut production in California, and 1,3-D use may be limited by moisture factors when 1,3-D is not an effective nematicide in heavy soils of an orchard and soils with greater than 12% moisture. In this situation MB is critical and its use is of considerable effectiveness in light of the longevity of walnut orchards and importance of early tree health to long producing orchards. It requires 8-10 years for trees to produce a saleable crop and the failure to start the orchard with healthy trees or in a pathogen infested site will reduce production over its 40 year life. Improper orchard replant can lead to additional replant within 10 years with no production in the interim.

CALIFORNIA WALNUT COMMISSION. 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

MB is the most biologically active and cost effective treatment for the one time replant application. Starting an orchard with "clean" plantings, which will accelerate tree growth and improve production, is a requirement that alternatives can not achieve under many orchard replant situations. Consequently the risk of using alternatives without the success rate of MB presents a difficult situation for growers. 1,3-D has been very effective in locations where soil, moisture, and legal restrictions are not problematic. Where 1,3-D is not an acceptable treatment, MB is critical to the establishment of the walnut orchard. This includes a significant number of walnut orchards.

It is known (McKenry, 1999) that some cultural practices can be instituted to reduce the effects of replant problems. It is generally true that replant problems are worse in sandy or alkaline soils. It is also known that walnuts grow better replanting after almond orchards (or grapes) rather than after walnuts. Unfortunately, many growers do not have choices of replant since land is limited and choices must be made for future returns of a long term crop. McKenry (1999) outlines several approaches through field research studies that can help to address MB alternatives for walnuts, as well as grapes, stone fruit, and almonds. These include use (combinations) of herbicides to kill remnant roots, use of fallow, use of "virgin" soil as an amendment to possibly reduce replant problem, resistant rootstocks when available, irrigation regimes to improve consistency of metam-sodium, etc. Field studies on these perennial crops require considerable time to conduct and until replicated trials can be analyzed MB is required.

California Walnut Commission. Summary of Technical Feasibility

No alternatives are feasible in the majority of walnut orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). In 1999, it was estimated (McKenry, 1999) that 85% of land used for California walnuts was infested with one or more of three important nematode pests (*Pratylenchus vulnus*, *Criconemella xenoplax*, or *Meloidogyne* spp.). Studies of individual pest populations tell only a small portion of the story of replant complex, since individual pests cause only a portion of the adverse growth effects. As with the stone fruit orchards, orchard replant problems for walnut orchards are a result of biological and environmental causes, and probably interactions of these forces. Unfortunately, there are no commercially available resistant rootstocks that can provide consistent relief from orchard replant problem in walnuts. It is clear that the long life of orchards requires that optimal pest management strategies be employed to overcome replant disorder during the one opportunity available—at orchard establishment. The long history of 1,3-D use in California suggests that at optimal conditions it (or in combination with another chemical) is the best alternative to MB. However, the reality of California orchard locations precludes the majority of growers taking advantage of the material since either township caps or soil texture/moisture issues reduces efficacy or legal availability to 1,3-D. Therefore, for the near future, for the orchard and vineyard sector in California, MB is critical to the efficient management of many of these commercial operations.

Almond Hullers & Processors Association. Part B: Crop Characteristics and Methyl Bromide Use

Almond Hullers & Processors Association. 10. Key Diseases and Weeds for which Methyl Bromide Is Requested and Specific Reasons for this Request:

Almond Hullers & Processors Association. Table 10.1: Key Diseases and Weeds and Reason for Methyl Bromide Request

Region where methyl bromide use is requested	Key pests	Specific reasons why methyl bromide is needed
Almond Hullers and Processors Association (California)	Replant problem is a disease complex comprising an interaction of pests (primarily nematodes) and environmental factors. Nematodes: *Meloidogyne incognita* (root knot), *Pratylenchus vulnus* (root lesion), *Mesocriconema xenoplax* (ring), *Xiphinema americanum* (dagger)	Many new almond orchards were planted between 1979 and 1982. These orchards will soon need to be replanted as the life of the orchard is reaching its maximum (25-30 years). Because no virgin land is available, replant problems will occur in these locations. Because of township caps and water moisture issues, the best alternative, 1,3-D is not available or effective as a replacement. Therefore, MB is considered critical for this industry.

ALMOND HULLERS & PROCESSORS ASSOCIATION. 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE
(Place major attention on the key characteristics that affect the uptake of alternatives):

The demand for almonds in the future is increasing, thus from 2005, it is estimated that there will be numerous orchards replanted to almonds that were originally planted from 1979-1982, in addition to other orchards that will be replanted to almonds. This crop, like others in this sector are infrequent users of MB, since fumigation occurs only once in the long life of the orchard.

The typical practice of replanting orchards with MB is to remove the old trees after the final harvest (typically 20-25 years after planting). The soil is harrowed and the remaining roots are removed. The soil is fumigated in the late fall and the trees are replanted in the early winter. When using MB growers have traditionally not needed to leave a fallow period between tree removal and the replanting of the new trees.

The typical practice of replanting orchards with 1,3-D + chloropicrin (the best alternative where conditions permit), is to remove the old trees after harvest and as many of the roots as time and resources permit. After the removal of the old trees the soil is ripped and then irrigated to allow the soil to settle. Any roots that are pulled to the surface are removed, and the soil is graded.

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	REGION D
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	almond trees
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	perennial (25-30 years)
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	none
SOIL TYPES: *(Sand, loam, clay, etc.)*	light, medium, heavy
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	once in 25 to 30 years
OTHER RELEVANT FACTORS:	No other relevant factors were identified by the applicant.

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA plant hardiness zones 9a, 9b											
RAINFALL *(mm):*30-60 CM/YR	16	72.1	17.3	0	trace	1.0	trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)*	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE	1st year, land preparation and fumigation; no additional fumigation for life of orchard (~25 to 30 years)											
PLANTING SCHEDULE	occurs 2nd year, after fumigation											
KEY MARKET WINDOW:	Not applicable											

*For Fresno, California

ALMOND HULLERS & PROCESSORS ASSOCIATION. 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Orchard replant into previously planted orchard land (the typical situation in California) requires reducing pathogen populations (mostly nematodes and fungi) and nutrient sources of previous orchard tree roots and root remnants. This requires an effective material that is volatile and can penetrate into the soil to reach these plant materials. In sandy, loam soils, where restrictions do not apply, 1,3-D may be an acceptable alternative that can penetrate to the target areas. In other situations, this compound and other alternatives are not able to move sufficiently through the soil to remove the problem pests. Thus, there is a critical need for MB for the almond consortium, as well as for other consortia of this sector. The infrequent use of MB (once in 25-40 years, or longer) and the positive benefits of vigorous early tree growth make MB a key component of orchard fruit and nut production.

ALMOND HULLERS & PROCESSORS ASSOCIATION. 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
AREA TREATED *(hectares)*	3,102	1,613	2,046	1,430	496	139 (+ need for individual tree replacement—i.e., "hole" amt.
RATIO OF FLAT FUMIGATION [a] METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]	usually Flat Fumigation [if strip—65% of area is treated]
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	1,314,601	547,622	703,401	497,810	174,502	41,774
FORMULATIONS OF METHYL BROMIDE *(methyl bromide/chloropicrin)*	98:2	98:2	98:2	98:2	98:2	98:2
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	shank injected	shank injected	shank injected	shank injected	shank injected	Shank injected
APPLICATION RATE [ACTIVE INGREDIENT] **(kg/ha*)**	424	340	344	348	352	300
APPLICATION RATE [FORMULATION] **(kg/ha*)**	433	347	351	355	359	306
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	28	22	22	23	23	20

** For Flat Fumigation treatment application rate and dosage rate may be the same.*

[a] Various methods are used depending on the particular nursery, fumigation can be Flat Fumigation, strip, or even "by the hole" (for individual tree replacement; MB is the only product that has acceptable technology for hole application—approximately 0.5 kg/tree).

ALMOND HULLERS & PROCESSORS ASSOCIATION. PART C: TECHNICAL VALIDATION

ALMOND HULLERS & PROCESSORS ASSOCIATION. 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

(Give list of all relevant chemical and non chemical alternatives, and their combinations)

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-D	can be effective in orchards with light soils; not feasible in medium or heavy soils; usually more effective for orchard replant problems with chloropicrin for added fungicidal activity; subject to township caps and specific moisture requirements.	only with light soils, if no legal restrictions apply
chloropicrin	may perform acceptably alone when fungi are primary cause of orchard replant problem; for nematode causation, MB or 1,3-D is necessary	no
metam-sodium	not an effective nematicide since it can not reach deep areas of soil, which is the primary cause of orchard replant problems; generally not effective in areas where water percolation is a problem (e.g., clay soils).	no
dazomet	This alternative has been examined by researchers and is inconsistent in field trials. This has been deemed not feasible due to lack of performance in field trials and inability to penetrate and kill nematodes at depths required for orchard replant acceptability. This product requires that there be uniform saturation of the granules to ensure that the product will perform consistently. This is not feasible in a typical orchard situation.	no
nematicides	Other nematicides (besides 1,3-D) have limited use due to their lack of performance or due to regulatory issues. Therefore, this product was deemed not feasible	no

NON CHEMICAL ALTERNATIVES		
fallow	not sufficient alone; sometimes done regardless of fumigant that follows; may require 4-10 year fallow for some crops (McKenry, 1999) and may not be sufficient even then; may provide partial control in some crops, however, economically difficult for grower to sustain (Browne et al., 2002b; Trout et al., 2002)	no
rootstock	similar situation to stone fruit, rootstocks can help reduce some problem nematodes but are not tolerant to an array of pests, and do not address overall replant "complex"	no
biofumigation, solarization, steam, Biological Control, cover crops and mulching, crop rotation / fallow, crop residue and compost, substrate/plug plants, plowing/tillage, resistant cultivars, grafting/resistant rootstock, physical removal, organic amendments/compost, general IPM	Each of the not in kind alternatives were listed as options for replacement of MB. Many of these alternatives are currently being employed with current replant practices. Alternatives such as biofumigation, solarization, and steam are not feasible due to planting times, one time fumigation requirement per orchard (steam treatment), or inability to attain sufficient biomass of plant material (biofumigation). Biological control may have promise but research has not identified agents that can be used on a commercial scale or that work consistently well. The University of California is investigating biological control of major fungal pathogens, but this work is still in the early stages of research. As such, MB is currently considered critical to the industry	no

COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin	effective against nematodes, fungi, and to kill remnant roots when 1,3-D is used in orchards with light soils; not feasible in medium or heavy soils; subject to township caps and specific moisture requirements.	only with light soils, if no legal restrictions apply
1,3-D + chloropicrin + metam-sodium		only with light soils, if no legal restrictions apply
1,3-D + metam-sodium		only with light soils, if no legal restrictions apply

** Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.*

ALMOND HULLERS & PROCESSORS ASSOCIATION. 14. LIST AND DISCUSS WHY REGISTERED *(and Potential)* PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE:

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
herbicides (e.g., triclopyr, glyphosate)	Not acceptable treatment alone. Herbicides are used for killing remnant roots of previous orchard plants; research with walnuts (McKenry, 1999) suggested that herbicide treatment followed by 18 months fallow can result in root knot nematode control of 97% compared to untreated plots. However, this effect only lasted 6 months, not long enough to achieve acceptable establishment of new orchard; no herbicides were found that kill grape roots (McKenry, 1999). In stone fruit, while remnant roots were killed after 18 months, endoparasitic nematodes were not significantly reduced (McKenry et al., 1995). The combination of herbicide costs plus additional 18 months waiting period prior to planting, becomes an economic burden, especially with the limited effectiveness of treatment.

ALMOND HULLERS & PROCESSORS ASSOCIATION. 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS *State if registered for this crop, registered for crop but use restricted, registered for other crops but not target crop, or not registered*	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
sodium azide	not registered in U.S., no registration package has been received	No	unknown
propargyl bromide	not registered in U.S., no registration package has been received	No	unknown
iodomethane	not registered in U.S.	Yes	unknown

Almond Hullers & Processors Association. 16. State Relative Effectiveness of Relevant Alternatives Compared to Methyl Bromide for the Specific Key Target Pests and Weeds for which It Is Being Requested

Almond Hullers & Processors Association. Table 16.1: Effectiveness of Alternatives – Replant Disorder.

Key Pest: Replant disorder	Average disease % or rating and yields in past 3~5 years				
Methyl Bromide formulations and Alternatives *(include dosage rates and application method)*	**# of Trials**	**Disease (% or rating)**	**# of Trials**	**Actual Yields (t/ha)**	**Citation**
fungal pathogens [1] MB (409 kg/ha) [2] chloropicrin (425 kg/ha) [3] 1,3-D (409 kg/ha) [4] non-fumigated	Almond (Marianna 2624 rootstock), 2001; 4 reps, research plots (19 m x 22 m), no tarp;	**Trunk diameter (mm)** (increase after 8 months post-fumigation) [1] 4b [2] 10c [3] 2a [4] 1a	same	**Trees (%) w/growth >1.5 m height (in 8 months):** [1] 21%a [2] 96%b [3] 1%a [4] 2%a	Browne et al., 2002b
fungal pathogens [1] MB (0.34 kg/tree) + chloropicrin (0.11 kg/tree) [2] chloropicrin (0.45 kg/tree) [3] non-fumigated	Almond (Marianna 2624 rootstock), 2002; 4 reps, research plots (19 m x 22 m), no tarp;	**Trunk diameter (mm)** (increase after 8 months post-fumigation) [1] 15b [2] 14b [3] 4a	same	**Trees (%) w/growth >1.5 m height (in 8 months):** [1] 94% [2] 83% [3] 6%	Browne et al., 2002b

ALMOND HULLERS & PROCESSORS ASSOCIATION. TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

***No** alternatives are feasible in the majority of orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). Listed below are alternatives for sites where soils are amenable to 1,3-D and where township caps are not applicable.*

ALTERNATIVE*	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D (385 kg/ha)	nematodes, roots	0-20% (based on research plots)	10% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (265 kg/ha) + chloropicrin (150 kg/ha) + metam-sodium (65 kg/ha)	nematodes, fungi, roots	0-10% (based on research plots)	5% (based on research plots)
1,3-D (350 kg/ha) + metam-sodium (125 kg/ha)	nematodes, roots	0-10% (based on research plots)	5% (based on research plots)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			See discussion above

*1,3-D is not a feasible alternative where soil moisture is not optimal or where township caps restrict its use.

ALMOND HULLERS & PROCESSORS ASSOCIATION. 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

1,3-D is the primary alternative to MB in areas where it is effective (light soils, moisture <12% at 1.5 meters, high moisture above 30 cm) and allowed. Previously discussed alternatives are the primary ones continuing to be examined. Alternatives that are being investigated include fallowing studies (frequently with prior treatment with an herbicide to kill remnant roots from previous plantings). Thus far, nematode control is short-lived (only up to 6 to 9 months) (6). Rootstock with resistance to the primary nematode pests are being developed, but orchard replant disorder is caused by varying factors that are different in different orchard locations and according to the crop grown (and crop grown prior to the orchard replant).

ALMOND HULLERS & PROCESSORS ASSOCIATION. 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

Use of herbicides can reduce remnant roots of previous plantings and reduce the nutrients used by problem nematodes, but fumigants are still a necessary component. In addition, in orchards not subject to restrictions, 1,3-D can be in some situations an acceptable alternative. However, as with the other commodities of this sector, there are numerous uncertainties in effects of orchard replant problems that a sound practice is to provide the initial trees the optimal environment to allow a highly productive and long-lived orchard—this translates to MB once in the life of the orchard. Tests are being conducted to develop new delivery systems to target pests with alternatives such as metam-sodium and 1,3-D to depths where these compounds can more efficiently kill roots and nematodes that feed on roots. McKenry (1999) outlines several approaches through field research studies that can help address MB alternatives for almonds, as well as walnuts, grapes, and stone fruit. These include use (combinations) of herbicides to kill remnant roots, use of fallow, use of “virgin” soil as an amendment to possibly reduce replant problem, resistant rootstocks when available, irrigation regimes to improve consistency of metam-sodium, etc. Field studies on these perennial crops require considerable time to conduct and until replicated trials can be analyzed MB is required.

ALMOND HULLERS & PROCESSORS ASSOCIATION. SUMMARY OF TECHNICAL FEASIBILITY

No alternatives are feasible in the majority of almond orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of trees are likely to be greater than 20% (McKenry, 1999). As with the other commodities of the orchard replant sector, replant problems for almonds are a result of biological and environmental causes, and interactions of these forces. Studies of individual pest populations tell only a small portion of the story of replant complex, since individual pests cause only a portion of the adverse growth effects. Nevertheless, approximately 35% of hectares planted in almonds have infestations of *Criconemella xenoplax* and/or *Pratylenchus vulnus* (McKenry, 1999). Nemaguard, the most commonly used almond rootstock, has resistance only to *Meloidogyne* spp. As such, it is clear that the long life of orchards requires that optimal pest management strategies be employed to overcome replant disorder during the one opportunity available—at orchard establishment. The long history of 1,3-D use in California suggests that at optimal conditions it (or in combination with another chemical) is the best alternative to MB. However, the reality of California orchards and vineyards locations precludes the majority of growers taking advantage of the material since either township caps or soil texture/moisture issues reduces efficacy or legal availability to 1,3-D. Therefore, for the near future, for the orchard and vineyard sector in California, MB is critical to the efficient management of many of these commercial operations.

PART D: EMISSION CONTROL

Research is being conducted among all the orchard replant commodities to address the orchard replant disorder complex. Fumigation is only one means of achieving optimal orchard establishment. Other practices can reduce long-term effects of pathogens and biotic and abiotic causes of this disorder. Such practices as fallowing land, strategic fertilization, water management, development of genetically robust rootstocks, deep injection of chemicals—all will reduce the emissions of MB (or other of the toxic chemicals that might be alternatives). Current research also includes studies with soil amendments, such as thiosulfate fertilizers that may act as barriers or absorbents of MB and reduce emissions.

19. TECHNIQUES THAT HAVE AND WILL BE USED TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS IN THE PARTICULAR USE: *(State % adoption or describe change)*

TABLE 19.1: TECHNIQUES TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS

TECHNIQUE OR STEP TAKEN	VIF OR HIGH BARRIER FILMS	METHYL BROMIDE DOSAGE REDUCTION	INCREASED % CHLOROPICRIN IN METHYL BROMIDE FORMULATION	LESS FREQUENT APPLICATION
WHAT USE/EMISSION REDUCTION METHODS ARE PRESENTLY ADOPTED?	VIF and high density tarps being tested (almond)	testing reduction from 98:2 to 75:25 (almond)	when fungal pathogens are main concern chloropicrin percent is increased	fumigation is applied only once in 20-40 years for this sector
WHAT FURTHER USE/EMISSION REDUCTION STEPS WILL BE TAKEN FOR THE METHYL BROMIDE USED FOR CRITICAL USES?	testing	deep injection; use of additional herbicides to kill remnant roots to increase efficacy of MB and other fumigants; reduction of MB in formulation	deep injection, increased chloropicrin in formulation to 50:50 being examined	fumigation is applied only once in 20-40 years for this sector
OTHER MEASURES *(please describe)*	unidentified	combination of chemicals and cultural practices such as fallow + alternatives or reduced MB	combination of chemicals and cultural practices such as fallow + alternatives or reduced MB	fumigation is applied only once in 20-40 years for this sector

Various techniques are being studied to improve the efficacy of alternatives. Primary is the development of application techniques to improve delivery of the best alternatives such as 1,3-D and metam-sodium (e.g., McKenry, 2001). In situations with no township caps, and where soil moisture is less than 12% at 1.5 meters, 1,3-D may be effective—this would occur generally in orchards with light, sandy soils. There is interest in the industry to increase 1,3-D application rates to improve efficacy in soils with up to 20% moisture, but label restrictions are based on health and environmental concerns and increased label rates are unlikely. Because township caps may apply to replant sites, and soil moisture reduces efficacy of alternatives in numerous orchard locations, MB use is unlikely to become less critical in the near future. However, because of the unique cropping system of these orchards (i.e., orchard replants, and therefore fumigation, is necessary only once in the life of the orchard—20-40 years, or even longer) the use of MB by this sector is cost effective and of high value, while of relatively low impact.

20. If Methyl Bromide Emission Reduction Techniques Are Not Being Used, or Are Not Planned for the Circumstances of the Nomination, State Reasons:

Research is currently being conducted by all commodities of this sector to find increasingly more effective ways of managing orchard replant disorder (e.g., Browne et al., 2002b; Ferris and Walker, 2002; Martin, 2003; McKenry, 1999, 2001; Schneider et al., 1999, 2000; Trout et al., 2001). From 1992 to 2002, the expenditures on research have included $430,000 (California Walnut Commission), $250,000 (California Grape and Tree Fruit League), and $86,000 (Almond Hullers and Processors Association). Research by all of these crop associations is continuing. This industry is committed to reduction in MB use. Currently there is use of MB only once in 20 to 40 years, but ongoing tests to determine the best approach to producing high quality fruit and nuts as well as reducing MB emissions can help integrate new techniques. These include herbicide strategies to kill remnant roots more efficiently, fallowing regimes that will not result in a significant delay in replant, and deep injection to improve efficacy.

Part E: Economic Assessment

21. Costs of Alternatives Compared to Methyl Bromide Over 3-Year Period:

TABLE 21.1: COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

This table is not included since none of the alternatives are technically feasible. See Summary of Economic Feasibility below.

22. Gross and Net Revenue:

TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

These tables are not included since none of the alternatives are technically feasible. See Summary of Economic Feasibility below.

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE – STONE FRUIT - TABLE E.1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA GRAPE AND TREE FRUIT LEAGUE – RAISIN AND TABLE GRAPES - TABLE E.2: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA WALNUT COMMISSION - TABLE E.3: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES
ALMOND HULLERS & PROCESSORS ASSOCIATION - TABLE E.4: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

These tables are not included since none of the alternatives are technically feasible. See Summary of Economic Feasibility below.

SUMMARY OF ECONOMIC FEASIBILITY

An economic analysis was not done for this sector because most of the losses cannot be quantified. The critical use nomination (CUN) for this sector does not include areas where soil conditions are ideal and township caps do not restrict the use of 1,3 dichloropropene (1,3 D). This CUN only applies to areas where township caps or certain soil types do not permit the use or effective use of 1,3 D. In such areas there are no technically or economically feasible alternatives and tree losses are likely to be greater than 20% (McKenry, 1999). 1,3 D in combinations with chloropicrin or metam sodium is economically feasible in ideal soil conditions when not restricted California township caps on 1,3 D. Where soil conditions permit the effective use of 1,3 D an estimated 5% tree loss is expected from the use of 1,3 D in various combinations with chloropicrin and metam sodium. A 5% tree loss results in a moderate loss, which is economically feasible providing there are no other losses.

Where 1,3 D is not permitted there are no effective nematicides. Trees that survive are likely not to be as healthy and are likely to suffer yield losses. Many trees are not likely to survive. Also, it is unlikely that replacement trees would be able to survive. If a nematode infestation causes the death of trees, then replacement trees would also suffer the same infestation without an effective nematicide or possibly many years of fallow.

An economic analysis was not done because most of the losses cannot be quantified because there are no data to substantiate the magnitude of these losses. These losses include:

- Delayed planting
- Fallow
- Additional use of herbicides
- Tree loss
- Replant costs to replace tree losses
- Loss of trees replanted
- Yield loss of fruit or nuts

A number of soil pathogens and nematodes, many still poorly understood, amass over the lifespan of an orchard. It is important that the grower be able to reduce the amount of inoculum in the soil to ensure that the young trees have the opportunity to get off to a vigorous start to ensure survival. 1,3 D alone or in conjunction with chloropicrin or metam-sodium have shown promise on some soil types, but long-term research on tree survival and on yield impacts is incomplete. If the alternatives do not work as effectively as methyl bromide, then it is possible that other losses could occur, such as additional replanting, higher yield losses, and shorter lifespan of the whole orchard reducing the ability to amortize the initial investment costs.

PART F. FUTURE PLANS

23. WHAT ACTIONS WILL BE TAKEN TO RAPIDLY DEVELOP AND DEPLOY ALTERNATIVES FOR THIS CROP?

Primarily, development of technologies to improve efficacy of alternatives such as deep injection methods, soil moisture management by improving drip technologies, use of fallow, experience with chemical/non-chemical combinations. Even where MB is considered critical, an improvement in efficient delivery techniques will result in reduction of MB use requirements. Considering that this sector uses MB (or other fumigants) only once in the life of the orchard, deployment of alternatives to replace MB will have to be well considered in light of the long-term impact on fruit and nut production. As previously described, McKenry (1999) has outlined several approaches through field research studies that can help address MB alternatives for almonds, as well as walnuts, grapes, and stone fruit. These include use (combinations) of herbicides to kill remnant roots, use of fallow, use of "virgin" soil as an amendment to possibly reduce replant problem, resistant rootstocks when available, irrigation regimes to improve consistency of metam-sodium, etc. Field studies on these perennial crops require considerable time to conduct and until replicated trials can be analyzed MB is required.

The amount of methyl bromide requested for research purposes is considered critical for the development of effective alternatives. Without methyl bromide for use as a standard treatment, the research studies can never address the comparative performance of alternatives. This would be a serious impediment to the development of alternative strategies. The U.S. government estimates that orchard replant research will require 1658 kg per year of methyl bromide for 2005 and 2006. This amount of methyl bromide is necessary to conduct research on alternatives and is in addition to the amounts requested in the submitted CUE applications. Two examples are five year field studies on orchard and vineyard comparing methyl bromide to 1,3-D, chloropicrin, iodomethane, fallow, cover crops, solarization, and other treatments for control of nematodes and unknown soilborne pests.

24. ARE THERE PLANS TO MINIMIZE THE USE OF METHYL BROMIDE FOR THE CRITICAL USE IN THE FUTURE?

As stated in Section 23, minimizing use of MB can be achieved through the development of technologies to improve efficacy of alternatives, such as deep injection methods or soil moisture management, and still have reasonable cost effectiveness. Even where MB is considered critical, an improvement in efficient delivery techniques will result in reduction of MB use requirements, even though use of MB is only once in the long life of these orchards. Research that is currently being conducted by all of the crop groups of this sector should help identify strategies to most effectively manage replant disorder. The U.S. wants to note that our usage rate is among the lowest in the world in requested sectors and represents efforts of both the government and the user community over many years to reduce use rates and emissions. We will continue to work with the user community in each sector to identify further opportunities to reduce methyl bromide use and emissions.

25. ADDITIONAL COMMENTS ON THE NOMINATION?

This methyl bromide critical use exemption nomination for orchard replant has been reviewed by the United States government and meets the guidelines of The *Montreal Protocol on Substances That Deplete the Ozone Layer*. This use is considered critical because there are no feasible alternatives or substitutes available for nurseries. MB is critical in the numerous orchards where 1,3-D will not be an effective treatment to orchard replant disorder, especially where orchards have medium to heavy soils, and/or township cap restrictions for 1,3-D. Under these circumstances MB is critical for orchards where 1,3-D is not effective or legal, and the absence of MB will result in a significant burden for the important fruit and nut industries of California.

26. CITATIONS

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APPENDIX A. 2006 Methyl Bromide Usage Numerical Index (BUNI).

Methyl Bromide Critical Use Exemption Process — Date: 2/26/2004 — Average Hectares in the US: not available

2006 Methyl Bromide Usage Numerical Index (BUNI) — Sector: ORCHARD REPLANT — % of Average Hectares Requested: not available

REGION	2006 Amount of Request: Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	1997~2001 Average Use*: Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Quarantine and Pre-Shipment	Regional Hectares**: 2001 & 2002 Average	% of 2001 & 2002 Average	% of Requested Hectares
CA Grape & Tree Fruit League - Stone Fruits	716,449	2,131	336	844,600	2,512	336	0%	not available	not available	not available
CA Grape & Tree Fruit League - Grapes	165,561	433	382	116,782	327	357	0%	not available	not available	not available
CA Walnut Commission	226,796	809	280	97,078	485	200	0%	not available	not available	not available
Almond Hullers & Processors Association	176,901	486	364	647,587	1,737	373	0%	not available	not available	not available
TOTAL OR AVERAGE	1,285,707	3,859	341	1,706,048	5,061	317	0%	not available	not available	not available

2006 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE			
REGION	2006 Request	(-) Double Counting	(-) Growth or 2002 CUE Comparison	(-) Use Rate Difference	(-) QPS	HIGH	LOW	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	% Reduction
CA Grape & Tree Fruit League - Stone Fruits	716,449	-	-	-	-	587,488	415,540	553,098	1,645	336	23%
CA Grape & Tree Fruit League - Grapes	165,561	-	40,502	8,277	-	81,747	67,733	78,944	221	357	52%
CA Walnut Commission	226,796	-	90,991	38,727	-	97,078	89,312	95,525	477	200	58%
Almond Hullers & Processors Association	176,901	-	-	-	-	136,214	102,603	129,491	355	364	27%
Nomination Amount	1,285,707	1,285,707	1,154,214	1,107,210	1,107,210	902,527	675,188	859,758	2,698	319	33%
% Reduction from Initial Request	0%	0%	10%	14%	14%	30%	47%	33%	30%		

Adjustments to Requested Amounts	Use Rate (kg/ha)		(%) Karst Topography		(%) 100 ft Buffer Zones		(%) Key Pest Distribution		Regulatory Issues (%)		Unsuitable Terrain (%)		Unsuitable Soil (%)		Combined Impacts (%)	
REGION	2006	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	HIGH	LOW
CA Grape & Tree Fruit League - Stone Fruits	336	336	0	0	0	0	60	35	8	2	0	0	50	35	82%	58%
CA Grape & Tree Fruit League - Grapes	382	357	0	0	0	0	35	35	8	2	0	0	50	35	70%	58%
CA Walnut Commission	280	200	0	0	0	0	85	85	8	2	0	0	50	35	100%	92%
Almond Hullers & Processors Association	364	364	0	0	0	0	50	35	8	2	0	0	50	35	77%	58%

Other Considerations	Dichotomous Variables (Y/N)					Other Issues			Economic Analysis					
REGION	Strip Bed Treatment	Currently Use Alternatives?	Research / Transition Plans	Tarps / Deep Injection Used	Pest-free Cert. Requirement	Change from Prior CUE Request (+/-)	Verified Historic MB Use / State	Frequency of Treatment	Loss per Hectare (US$/ha)	Loss per Kilogram of MB (US$/kg)	Loss as a % of Gross Revenue	Loss as a % of Net Revenue	Quality/ Time/ Market Window/ Yield Loss (%)	Marginal Strategy
CA Grape & Tree Fruit League - Stone Fruits	Y+N	Yes	Yes	Deep	No	0	Yes	1 / 20					5% Yield Loss	1,3-D+MS/ 1,3-D+MS+Pic/ 1,3-D+Pic
CA Grape & Tree Fruit League - Grapes	No	Yes	Yes	Deep	No	0	Yes	1 / 20					5% Yield Loss	1,3-D+MS/ 1,3-D+MS+Pic/ 1,3-D+Pic
CA Walnut Commission	No	Yes	Yes	Deep	No	0	Yes	1 / 40					5% Yield Loss	1,3-D+MS/ 1,3-D+MS+Pic/ 1,3-D+Pic
Almond Hullers & Processors Association	Y+N	Yes	Yes	Deep	No	+[3]	Yes	1 / 20					5% Yield Loss	1,3-D+MS/ 1,3-D+MS+Pic/ 1,3-D+Pic

Alternatives 1,3-D may not be suitable due to soil type, pests or township caps

Notes * Due to the nature of these applications, the historical reported data varies greatly from year to year. Therefore an average of the usage from 1997 through 2001 were used.

1 CA Grape & Tree Fruit League - Stone Fruit requested 8100 acres but only 65% of those acres are fumigated due to strip bed treatment, therefore the acreage was adjusted downward.

2 CA Grape & Tree Fruit League - Stone Fruit reported historical use rates that were grossly underestimated for normal fumigation use. A use rate of 300 pounds ai/acre was multiplied by the reported acreage to reflect a more accurate estimate of methyl bromide used.

3 This applicant only replanted every 20 years, so change from 2002 is not necessarily relevant since replant in 2002 reflects status of market in ~ 1982, which was less than planting in 1970s that are now being replanted.

Conversion Units: 1 Pound = 0.453592 Kilograms 1 Acre = 0.404686 Hectare

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

1. **Average Hectares in the US** – Average Hectares in the US is the average of 2001 and 2002 total hectares in the US in this crop when available. These figures were obtained from the USDA National Agricultural Statistics Service.
2. **% of Average Hectares Requested** - Percent (%) of Average Hectares Requested is the total area in the sector's request divided by the Average Hectares in the US. Note, however, that the NASS categories do not always correspond one to one with the sector nominations in the U.S. CUE nomination (e.g., roma and cherry tomatoes were included in the applicant's request, but were not included in NASS surveys). Values greater than 100 percent are due to the inclusion of these varieties in the U.S. CUE request that were not included in the USDA NASS: nevertheless, these numbers are often instructive in assessing the requested coverage of applications received from growers.
3. **2006 Amount of Request** – The 2006 amount of request is the actual amount requested by applicants given in total pounds active ingredient of methyl bromide, total acres of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per acre. U.S. units of measure were used to describe the initial request and then were converted to metric units to calculate the amount of the US nomination.
4. **2001 & 2002 Average Use** – The 2001 & 2002 Average Use is the average of the 2001 and 2002 historical usage figures provided by the applicants given in total pounds active ingredient of methyl bromide, total acres of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per acre. Adjustments are made when necessary due in part to unavailable 2002 estimates in which case only the 2001 average use figure is used.
5. **Quarantine and Pre-Shipment** – Quarantine and pre-shipment (QPS) hectares is the percentage (%) of the applicant's request subject to QPS treatments.
6. **Regional Hectares, 2001 & 2002 Average Hectares** – Regional Hectares, 2001 & 2002 Average Hectares is the 2001 and 2002 average estimate of hectares within the defined region. These figures are taken from various sources to ensure an accurate estimate. The sources are from the USDA National Agricultural Statistics Service and from other governmental sources such as the Georgia Acreage estimates.
7. **Regional Hectares, Requested Acreage %** - Regional Hectares, Requested Acreage % is the area in the applicant's request divided by the total area planted in that crop in the region covered by the request as found in the USDA National Agricultural Statistics Service (NASS). Note, however, that the NASS categories do not always correspond one to one with the sector nominations in the U.S. CUE nomination (e.g., roma and cherry tomatoes were included in the applicant's request, but were not included in NASS surveys). Values greater than 100 percent are due to the inclusion of these varieties in the U.S. CUE request that were not included in the USDA NASS: nevertheless, these numbers are often instructive in assessing the requested coverage of applications received from growers.
8. **2006 Nomination Options** – 2006 Nomination Options are the options of the inclusion of various factors used to adjust the initial applicant request into the nomination figure.
9. **Subtractions from Requested Amounts** – Subtractions from Requested Amounts are the elements that were subtracted from the initial request amount.
    10. **Subtractions from Requested Amounts, 2006 Request** – Subtractions from Requested Amounts, 2006 Request is the starting point for all calculations. This is the amount of the applicant request in kilograms.
    11. **Subtractions from Requested Amounts, Double Counting** - Subtractions from Requested Amounts, Double Counting is the estimate measured in kilograms in situations where an applicant has made a request for a CUE with an individual application while their consortium has also made a request for a CUE on their behalf in the consortium application. In these cases the double counting is removed from the consortium application and the individual application takes precedence.
    12. **Subtractions from Requested Amounts, Growth or 2002 CUE Comparison** - Subtractions from Requested Amounts, Growth or 2002 CUE Comparison is the greatest reduction of the estimate measured in kilograms of either the difference in the amount of methyl bromide requested by the applicant that is greater than that historically used or treated at a higher use rate or the difference in the 2006 request from an applicant's 2002 CUE application compared with the 2006 request from the applicant's 2003 CUE application.
    13. **Subtractions from Requested Amounts, QPS** - Subtractions from Requested Amounts, QPS is the estimate measured in kilograms of the request subject to QPS treatments. This subtraction estimate is calculated as the 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison then

multiplied by the percentage subject to QPS treatments. *Subtraction from Requested Amounts, QPS = (2006 Request – Double Counting – Growth)*(QPS %)*

14. **Subtraction from Requested Amounts, Use Rate Difference** – Subtractions from requested amounts, use rate difference is the estimate measured in kilograms of the lower of the historic use rate or the requested use rate. The subtraction estimate is calculated as the 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison, minus the QPS amount, if applicable, minus the difference between the requested use rate and the lowest use rate applied to the remaining hectares.

15. **Adjustments to Requested Amounts** – Adjustments to requested amounts were factors that reduced to total amount of methyl bromide requested by factoring in the specific situations were the applicant could use alternatives to methyl bromide. These are calculated as proportions of the total request. We have tried to make the adjustment to the requested amounts in the most appropriate category when the adjustment could fall into more than one category.
    16. **(%) Karst topography** – Percent karst topography is the proportion of the land area in a nomination that is characterized by karst formations. In these areas, the groundwater can easily become contaminated by pesticides or their residues. Regulations are often in place to control the use of pesticide of concern. Dade County, Florida, has a ban on the use of 1,3D due to its karst topography.
    17. **(%) 100 ft Buffer Zones** – Percentage of the acreage of a field where certain alternatives to methyl bromide cannot be used due the requirement that a 100 foot buffer be maintained between the application site and any inhabited structure.
    18. **(%) Key Pest Impacts** - Percent (%) of the requested area with moderate to severe pest problems. Key pests are those that are not adequately controlled by MB alternatives. For example, the key pest in Michigan peppers, *Phytophthora* spp. infests approximately 30% of the vegetable growing area. In southern states the key pest in peppers is nutsedge.
    19. **Regulatory Issues (%)** - Regulatory issues (%) is the percent (%) of the requested area where alternatives cannot be legally used (e.g., township caps) pursuant to state and local limits on their use.
    20. **Unsuitable Terrain (%)** – Unsuitable terrain (%) is the percent (%) of the requested area where alternatives cannot be used due to soil type (e.g., heavy clay soils may not show adequate performance) or terrain configuration, such as hilly terrain. Where the use of alternatives poses application and coverage problems.
    21. **Cold Soil Temperatures** – Cold soil temperatures is the proportion of the requested acreage where soil temperatures remain too low to enable the use of methyl bromide alternatives and still have sufficient time to produce the normal (one or two) number of crops per season or to allow harvest sufficiently early to obtain the high prices prevailing in the local market at the beginning of the season.
    22. **Combined Impacts (%)** - Total combined impacts are the percent (%) of the requested area where alternatives cannot be used due to key pest, regulatory, soil impacts, temperature, etc. In each case the total area impacted is the conjoined area that is impacted by any individual impact. The effects were assumed to be independently distributed unless contrary evidence was available (e.g., affects are known to be mutually exclusive). For example, if 50% of the requested area had moderate to severe key pest pressure and 50% of the requested area had karst topography, then 75% of the area was assumed to require methyl bromide rather than the alternative. This was calculated as follows: 50% affected by key pests and an additional 25% (50% of 50%) affected by karst topography.

23. **Qualifying Area** - Qualifying area (ha) is calculated by multiplying the adjusted hectares by the combined impacts.
24. **Use Rate** - Use rate is the lower of requested use rate for 2006 or the historic average use rate.
25. **CUE Nominated amount** - CUE nominated amount is calculated by multiplying the qualifying area by the use rate.
26. **Percent Reduction** - Percent reduction from initial request is the percentage of the initial request that did not qualify for the CUE nomination.
27. **Sum of CUE Nominations in Sector** - Self-explanatory.
28. **Total US Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.
29. **Dichotomous Variables** – dichotomous variables are those which take one of two values, for example, 0 or 1, yes or no. These variables were used to categorize the uses during the preparation of the nomination.
    30. **Strip Bed Treatment** – Strip bed treatment is 'yes' if the applicant uses such treatment, no otherwise.
    31. **Currently Use Alternatives** – Currently use alternatives is 'yes' if the applicant uses alternatives for some portion of pesticide use on the crop for which an application to use methyl bromide is made.

32. **Research/ Transition Plans** – Research/ Transition Plans is 'yes' when the applicant has indicated that there is research underway to test alternatives or if applicant has a plan to transition to alternatives.
33. **Tarps/ Deep Injection Used** – Because all pre-plant methyl bromide use in the US is either with tarps or by deep injection, this variable takes on the value 'tarp' when tarps are used and 'deep' when deep injection is used.
34. **Pest-free cert. Required** - This variable is a 'yes' when the product must be certified as 'pest-free' in order to be sold

35. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked
    36. **Change from Prior CUE Request**- This variable takes a '+' if the current request is larger than the previous request, a '0' if the current request is equal to the previous request, and a '-' if the current request is smaller that the previous request.
    37. **Verified Historic Use/ State**- This item indicates whether the amounts requested by administrative area have been compared to records of historic use in that area.
    38. **Frequency of Treatment** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
39. **Economic Analysis** – provides summary economic information for the applications.
    40. **Loss per Hectare** – This measures the total loss per hectare when a specific alternative is used in place of methyl bromide. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
    41. **Loss per Kilogram of Methyl Bromide** – This measures the total loss per kilogram of methyl bromide when it is replaced with an alternative. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
    42. **Loss as a % of Gross revenue** – This measures the loss as a proportion of gross (total) revenue. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
    43. **Loss as a % of Net Operating Revenue** -This measures loss as a proportion of total revenue minus operating costs. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars. This item is also called net cash returns.
44. **Quality/ Time/ Market Window/Yield Loss (%)** – When this measure is available it measures the sum of losses including quality losses, non-productive time, missed market windows and other yield losses when using the marginal strategy.
45. **Marginal Strategy** -This is the strategy that a particular methyl bromide user would use if not permitted to use methyl bromide.

APPENDIX B. SUMMARY OF NEW APPLICANTS

A number of new groups applied for methyl bromide for 2005 during this application cycle, as shown in the table below. Although in most cases they represent additional amounts for sectors that were already well-characterized sectors, in a few cases they comprised new sectors. Examples of the former include significant additional country (cured, uncooked) ham production; some additional request for tobacco transplant trays, and very minor amounts for pepper and eggplant production in lieu of tomato production in Michigan.

For the latter, there are two large requests: cut flower and foliage production in Florida and California ('Ornamentals') and a group of structures and process foods that we have termed 'Post-Harvest NPMA' which includes processed (generally wheat-based foods), spices and herbs, cocoa, dried milk, cheeses and small amounts of other commodities. There was also a small amount requested for field-grown tobacco.

The details of the case that there are no alternatives which are both technically and economically feasible are presented in the appropriate sector chapters, as are the requested amounts, suitably adjusted to ensure that no double-counting, growth, etc. were included and that the amount was only sufficient to cover situations (key pests, regulatory requirements, etc.) where alternatives could not be used.

The amount requested by new applicants is approximately 2.5% of the 1991 U.S. baseline, or about 1,400,000 pounds of methyl bromide, divided 40% for pre-plant uses and 60% for post-harvest needs.

The methodology for deriving the nominated amount used estimates that would result in the lowest amount of methyl bromide requested from the range produced by the analysis to ensure that adequate amounts of methyl bromide were available for critical needs. We are requesting additional methyl bromide in the amount of about 500,000 Kg, or 2% or the 1991 U.S. baseline, to provide for the additional critical needs in the pre-plant and post-harvest sector.

Applicant Name	2005 U.S. CUE Nomination (lbs)
California Cut Flower Commission	400,000
National Country Ham Association	1,172
Wayco Ham Company	39
California Date Commission	5,319
National Pest Management Association	319,369
Michigan Pepper Growers	20,904
Michigan Eggplant Growers	6,968
Burley & Dark Tobacco Growers USA - Transplant Trays	2,254
Burley & Dark Tobacco Growers USA - Field Grown	28,980
Virginia Tobacco Growers - Transplant Trays	941
Michigan Herbaceous Perennials	4,200

Ozark Country Hams	240
Nahunta Pork Center	248
American Association of Meat Processors	296,800
Total lbs	**1,087,434**
Total kgs	**493,252**