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 (Submitted in 2006 for 2008 Use Season)

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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.

☐ Yes ☐ No

Signature ____________ Name ____________ Date ____________

Title: ____________

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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

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PART A: SUMMARY

1. NOMINATING PARTY

The United States of America

2. DESCRIPTIVE TITLE OF NOMINATION

Methyl Bromide Critical Use Nomination for Preplant Soil Use for Orchard Replant (Prepared in 2005 for the 2008 Use Season)

3. CROP AND SUMMARY OF CROP SYSTEM

The Orchard Replant sector represents stone fruit, almond, and walnut orchards, and grapes grown in parts of California. Growers of all of these crops face a common threat—nematodes and a poorly understood disease complex called orchard replant "problem", or "disorder". The problem 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 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. Fumigation kills (or reduces) both pests and remnant roots, which harbor pests, of previous plantings. This pre-plant fumigation occurs only once in the life of the orchard and is the most biologically and economically effective treatment for establishing healthy, long-producing orchards. 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 restrictions. Consequently, 1,3-D is not effective in many orchard replant situations, which makes MeBr a critical tool to an orchard's long-term productivity. Research is being supported by the requesting consortia to develop new strategies to address important pest problems. For these types of perennial crops, however, efficacy must be tested before large scale commercial applications can be attempted. In the interim, growers are requesting critical use of MeBr to allow replanting of new orchards.

The typical practice of replanting orchards or vineyards is to remove the old trees after the final harvest and attempting to remove as much of the root system as possible. The soil is fumigated with MeBr in the late fall and the trees are replanted in late winter. With MB, growers may, or may not, schedule 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)
2008	**405,666**	**1,225**

** Includes research amoun of 1,658 kgt, See Appendix A for complete description of how the nominated amount was calculated.*

5. BRIEF SUMMARY OF THE NEED FOR METHYL BROMIDE AS A CRITICAL USE

The United States (U.S.) Nomination for orchard replant is for areas where alternatives are not suitable, either because of legal restrictions or physical features, such as unacceptable soil type or moisture. For many sites of orchard replant with stone fruit, grapes, walnuts, and almonds in California, MeBr is a critical tool for establishing healthy, long lived orchards. Where conditions are acceptable, growers in California currently use alternative measures to manage orchard replant disorder (Browne et al., 2002b; McKenry, 1999).

In U.S. orchard replant situations there are certain factors that make some alternatives to MeBr unsuitable. These include:

- The efficacy of alternatives may not be sufficient for commercial purposes in some areas, making these alternatives infeasible for use in orchard replant.
- Some alternatives may be comparable to MB, especially when key pests occur at low pressure, and in such cases the U.S. is only nominating a CUE where the key pest pressure is moderate to high.
- Regulatory constraints, such as 1,3-D limitations in California due to the township caps, make the best alternatives unavailable in some areas.
- The best alternative may not be suitable for use in certain soil conditions, such as excessive moisture 1-1.5 m deep.

Orchard replant “problem” or “disorder” presents a 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. Many aspects of the etiology of this disease complex are currently unknown. 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 was 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 by 99.9% in the top 1.5 meters, by effectively killing remnant roots from previous orchard trees.

It has long been observed that fumigation can improve 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 effective as, and more economical than, MeBr 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 MeBr 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, including township caps in California. The reduced rates 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 those with light soils and 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*	*Central California Winegrowers*	*California Walnut Commission*	*Almond Hullers & Processors Association*
AMOUNT OF APPLICANT REQUEST					
2008 Kilograms	716,449	309,460	97,988	226,796	206,384
AMOUNT OF NOMINATION*					
2008 Kilograms	248,724	17,034	43,186	35,268	59,795

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

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

The best alternative for orchard replant that has been identified thus far 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, for 2008, there is a critical need for MeBr in some 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 REPLANT AREA IN 2001 AND 2002 (HA) [AREA OF MEBR USE/TOTAL AREA REPLANTED PER YEAR]	PROPORTION OF TOTAL REPLANT AREA TREATED WITH METHYL BROMIDE PER 2001/2002 YEAR (%)
California Grape and Tree Fruit League—Stone Fruit	5,587 (2005 est.) (93,117 ha total x 6%)	20% (1,116/5,587)
California Grape and Tree Fruit League—Raisin & Table Grapes	4,219 (2005 est.) (14,065 ha total x 3%)	2% (82/4,219)
Central California Winegrowers—Wine Grapes	4,676 (2005 est.) (total 66,802 ha total x 7% replanted)	9% (421/4,676) (based on 2005 request—reported CDPR data may not be accurate)
California Walnut Commission	1851 (83,806 ha total bearing)	(810 ha requested) 75% of replant may be strip treated—50% of this use MB; 12.5% of replant use no fumigation
Almond Hullers & Processors Association	6,119 (202,429 ha total x 3%) replanted)	4% (266/6,119) (65% may be strip treated)
NATIONAL TOTAL:	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.

Some areas of California amenable to these crops have soil types and moisture characteristics that allow the use of alternative treatments. 1,3-D with chloropicrin is an effective alternative to MeBr in areas with soils that contain less than 12% moisture at 1.5 meters and can be sufficiently moistened in the top 30 cm. Areas considered in this nomination have either regulatory or other reasons (e.g., soil type) that prevent alternatives being effective in successfully managing replant problem.

As an example, the Central California Winegrowers represent growers in eight counties with approximately 165,000 acres of wine grapes. Each year, approximately 7% of the total area is replanted. Of this, approximately 15% is fumigated, and of the fumigated land approximately 60% is treated with MB. Therefore, 85% of the replanted vineyards use other means besides fumigation, and of the fumigated land, 40% use alternatives to MB. The proportion of land that is treated with MeBr is relatively small. Other growers in this sector experience similar situations, with varying percentages of MeBr use on replanted land. Stone fruit are most susceptible to orchard problems, and therefore a larger proportion of land is treated with MB. In general, the portion that is being requested for treatment with MeBr for 2008, is for soil types or terrain that are not amenable to 1,3-D use.

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?

Depending on the crop and the economic market when new orchards are established, between 9% and 60% of replanted areas will require MeBr for 2008. The balance of land planted to each of the five crops of this sector will use other means of pest management. Because research continues to define effective alternatives (e.g., Browne et al., 2004; Lampinen et al., 2004; Schneider et al., 2004), it may be possible to adopt some alternatives by improving application technologies in conjunction with crop rotation, fallow, rootstock, or use of VIF (use is regulated in California). MeBr is critical for the 2008 replant season for the areas not currently amenable to treatment with alternatives to MB.

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	Central California Winegrowers—Wine Grapes	California Walnut Commission	Almond Hullers & Processors Association
Year of Exemption Request	**2008**	**2008**	**2008**	**2008**	**2008**
Kilograms of Methyl Bromide	716,449	309,460	91,988	226,796	206,384
Use: Flat Fumigation[a] or Strip/Bed Treatment	Many orchards treated by strip fumigation (65% of area is treated)	Strip or broadcast fumigation	Usually strip fumigation (65% of area is treated)	Many orchards treated by strip fumigation—75% of replant may be strip fumigated	Many orchards treated by strip fumigation (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	98:2
Total Area to be treated with the methyl bromide or methyl bromide/Chloropicrin formulation *(ha)*	3,278	809	255	809	567
Application rate *(kg/ha)* [Active Ingredient]	336	382	360	280	364
Dosage rate* *(g/m²)* of **Active Ingredient on treated land**	33.6 (on strip treated land)	38.2	36.0 (on strip treated land)	28.0 (on strip treated land)	36.4 (on strip treated land)

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

[a] Various methods are used depending on the particular location, fumigation can be flat fumigation, strip, or even "by the hole" (for individual tree replacement; MeBr is the only product that has acceptable technology for hole application—approximately 0.5 kg/tree). Strip fumigation would comprise approximately 65% of the total area that is actually fumigated.

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

The amount of MeBr 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 MeBr 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.
- Only the area experiencing one or more of the following impacts were included in the

nominated amount: moderate to heavy key pest pressure, regulatory impacts, and unsuitable soils.

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)	1,3-D and chloropicrin are effective in reducing the effects of orchard replant disorder where there is low disease pressure or where there is light, sandy loam soils, and where there is acceptable soil moisture. Strategies that include multiple components, such as use of fallow and herbicides and nematicides, have the potential to reduce pest problems in orchard replant. Short term fallow along with nematode tolerant rootstock peach seedlings have looked promising in research trials (e.g., Browne, 2003b).

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

The typical practice for replanting orchards begins with the removal of old plantings after the final harvest. The soil is harrowed and the remaining roots are pulled. The soil is fumigated with MeBr in the late fall and the trees are replanted in the early winter. Even with MB, growers may leave a fallow period between tree removal and the replanting of the new trees, depending on orchard schedule requirements.

The typical practice of replanting orchards with 1,3-D + chloropicrin (the best alternative where conditions permit), begins with removing 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 hass not always been a fallow period between the removal of the old trees and replanting with new trees, but fallow is becoming a more established tool for pest management.

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; however, short term fallow along with nematode tolerant rootstock peach seedlings have looked promising in research trials (e.g., Browne, 2003b).
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, 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. *(°C)*	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, metam-sodium and 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 MeBr for 2008. The infrequent use of MeBr for orchard replant and the positive benefits of vigorous early tree growth make MeBr a key component of orchard fruit and nut production in areas where alternative methods are not effective.

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

YEARS	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	3,522	1,723	1,063	1,182	1,619	Not reported
	Hectares and Use Rate presented are for the treated strip.					
RATIO OF FLAT FUMIGATION [a] METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	strip—65% of area is treated	strip—65% of area is treated	strip—65% of area is treated	strip—65% of area is treated	strip—65% of area is treated	Not reported
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	1,283,092	627,526	387,354	430,754	589,670	Not reported
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	98:2	98:2	98:2	98:2	98:2	Not reported
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 reported
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha*)	364	364	364	364	364	Not reported
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)* *****	36.4	36.4	36.4	36.4	36.4	Not reported

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

[a] Various methods are used depending on the particular location, fumigation can be Flat Fumigation, strip, or even "by the hole" (for individual tree replacement; MeBr 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 activity as a fungicide and may be useful if fungi are significant causal agents of replant disorder (Trout et al., 2002); generally will not reduce nematodes significantly and they can be major pests of orchard replant; may have phytotoxicity problems at rates that are effective against pests (Browne et al., 2002a)	Alone, not effective for nematode problems
1,3-dichloropropene (1,3-D)	Some 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. Comparative yield with 1,3-D were valued at 5585 kg/ha versus 8903 kg/ha with MeBr (Duncan et al, 2003). At US$0.30 per kg peaches, this represents a significant economic impact.	Can be effective especially 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 cm when metam-sodium is applied at label rates; not an effective nematicide since it can not reach deep areas of soil; 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 MeBr (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). Comparative yield with metam-sodium were valued at 6880 kg/ha versus 8903 kg/ha with MeBr (Duncan et al, 2003). At US$0.30 per kg peaches, this represents a significant economic impact.	Possibly, in some situations
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	Generally fallow is not sufficient alone for high pest pressure areas; frequently done for one 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). However, short term fallow along with nematode tolerant rootstock peach seedlings have looked promising in research trials (e.g., Browne, 2003b, 2004).	Can reduce nematode populations—used in conjunction with other treatments in overall IPM program
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. Rootstocks 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. However, short term fallow along with nematode tolerant rootstock peach seedlings have looked promising in research trials (e.g., Browne, 2003b, 2004).	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. Drenovsky et al. (2005) found that black polyethylene promotes greater growth (trunk diameter) in the year following planting probably due to increased soil temperature. This work is continuing. 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, MeBr 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. Promising results from research trials indicated that efficacy may be improved by refining application protocols and use rates (see e.g., Browne et al., 2003a, 2004).	In some situations, especially where pathogens and nematodes are key pests, if no legal restrictions apply and
1,3-D + chloropicrin + metam-sodium		

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	Efficacy may be improved by incorporating fallow if economically feasible.	where soil type is amenable

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 effective 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	No registration package has been submitted	No	Unknown
Propargyl bromide	No registration package has been submitted	No	Unknown
Iodomethane	Not registered in U.S.	Yes	Unknown
Muscadore albus Strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

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] Untreated [2] MB (449 kg/ha) [3] 1,3-D (392 kg/ha) [4] Metam-sodium (358 kg/ha) [5] Polyethylene mulch [6] Sodium tetrathiocarbonate (113 L/ha) [7] Compost + microbial inoc. (5 appl/season) [8] Compost + kelp + humic acid (5 appl/season) [9] Compost + calcium (5 appl/season)	**Orchard replant, 4 reps** [1] n/a [2] preplant [3] preplant [4] preplant [5] postplant [6] postplant [7] postplant [8] postplant [9] pre- & postplant	**Trunk dia. ,1st year (cm)** [1] 11.2b [2] 15.8a [3] 12.8ab [4] 14.0ab [5] 13ab [6] 11.4b [7] 10.8b [8] 10.8b [9] 11.8b	4 reps each	**Pruning mass, 2nd year (kg/tree)** [1] 1.8b [2] 6.4a [3] 3.6b [4] 3.8b [5] 2.8b [6] 1.6b [7] 1.8b [8] 1.7b [9] 2b	Drenovsky et al., 2005
[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

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 below

Alternatives are used in most replant sites. MeBr is critical for 2008 for sites where conditions do allow effective use of alternatives (those with medium to heavy soils, and/or where township cap restrictions apply). In these cases losses of trees can be greater than 20% (McKenry, 1999). Sites well-suited to 1,3-D should have efficacy similar to MB.

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 soils, and available water to moisten the top 30 cm of soil, 1,3-D with chloropicrin and/or metam-sodium can be effective treatments for orchard replant problems. 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. Fallowing and crop rotation studies (Browne et al., 2003b, 2004) suggest orchard replant disorder can be reduced but further studies are needed to test on a commercial scale. Nematode control has been short-lived (only up to 6 to 9 months) in some studies (McKenry, 1999). In a research trial, establishing peach and almond orchards on previous vineyard soil appears to improve orchard establishment regardless of chemical fumigant (Browne et al., 2004; Lampinen et al., 2004). Tolerant rootstocks with resistance to the primary nematode pests are being developed, but orchard replant disorder is caused by varying factors that vary depending on orchard location 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 treat 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) outlined several approaches through field research studies that can help address MeBr alternatives for stone fruit, as well as walnuts, grapes, and almonds. These include use (combinations) of herbicides to kill remnant roots, use of fallow or cover crops, 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 MeBr is required (e.g., Browne et al., 2004; Lampinen, 2004).

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

For replant situations where alternatives are not effective, MeBr is considered critical to the healthy establishment of orchards. In those stone fruit orchard replant sites with medium to heavy soils and/or where township cap restrictions apply losses of trees could 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 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 locations precludes some growers from taking advantage of 1,3-D, since either township caps or soil texture/moisture issues reduce efficacy or legal availability. Therefore, for 2008, for stone fruit replant where alternatives are not effective, there is a critical need for MeBr for establishment of commercial operations. Currently, research is being conducted examining non-fumigant treatments. Some non-chemical treatments have shown promise in small-scale research trials, such as planting cover crops on previous vineyards (Browne, 2003b, 2004; Lampinen et al., 2004). Long term studies will continue to refine these types of treatments for commercial applications.

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 METHYL BROMIDE USE IS REQUESTED	KEY PESTS	SPECIFIC REASONS WHY METHYL BROMIDE IS 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 and chloropicrin, may be effective in reducing the effects of orchard replant disorder in vineyards, where there are no legal restriction, in light, sandy loam soils, and where there is acceptable soil moisture. For root knot and citrus nematode control, Inline and drip applied 1,3-D have showed good efficacy in research trials (Schneider et al., 2004). Rootstock "Harmony" has showed good efficacy against rootknot nematodes after six seasons, but poor efficacy against citrus nematodes (Schneider et al., 2004). In situations where soils are medium to heavy, or where township caps are applicable, MeBr is used to effectively target root remnants from previous orchard trees. Strategies that include multiple techniques, such as use of herbicides and fallow and nematicides, have the potential to reduce pest problems in replant. However, these combination techniques must first be tested and proven so as not to compromise orchard productivity. Some research suggests that long term fallow benefits diminished after four seasons (Schneider et al., 2004).

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 MeBr is to remove the old plantings 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 the early winter. When using MeBr growers may or may not fallow 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 vineyard											
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

YEARS	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	251	273	67	97	123	Not available
	Hectares and Use Rate presented are for the treated strip.					
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)*	108,035	70,732	18,248	20,175	34,618	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*)	430	259	271	208	280	Not available
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)* *****	43.0	25.9	27.1	21.0	28.0	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

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 can provide effective management of replant disorder in vineyards with light soils; usually more effective with chloropicrin.	Usually with light soils, if no legal restrictions apply
Metam-sodium	Not an effective nematicide in replant system 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—requires complementary chemical
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	Some products have been tested (McKenry, appendix to wine grape growers request for 2008 use season) but have not been sufficiently studied or effective to be considered alternatives. Products tested, or being tested, include: 30 products such as walnut tea, nicotinamide insecticide (Admire), Integrate (mineral extraction), Oxycom (peroxyacetic acide).	No
Sodium tetrathiocarbonate	This compound does not penetrate the old roots of the previous vineyard. Old roots 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. Generally this product is used in combination with other practices that will allow for successful replanting.	No
Non Chemical Alternatives		

<table>
<tr><th>Name of Alternative</th><th>Technical and regulatory* reasons for the alternative not being feasible or available</th><th>Is the alternative considered cost effective?</th></tr>
<tr><td>Fallow</td><td>Not sufficient alone; frequently done for one year regardless of fumigant that follows; may require 4-10 year fallow for some crops (Browne, 2002b) 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, however, economically difficult for grower to sustain (McKenry, 1999; McKenry et al., 1995).</td><td>No</td></tr>
<tr><td>Rootstock</td><td>Some rootstocks are available, such as Teleki 5C or Harmony, which can significantly reduce certain species of nematodes—but no multiple resistance. Used in combination with 1,3-D, significant reductions in rootknot and citrus nematodes have resulted in research tests (see Schneider et al., 2002, 2003; Ferris and Walker, 2002).</td><td>No</td></tr>
<tr><td>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</td><td>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, MeBr is currently considered critical to the industry.</td><td>No</td></tr>
<tr><td colspan="3">Combinations of Alternatives</td></tr>
<tr><td>1,3-D + chloropicrin</td><td rowspan="3">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. Promising results from research trials indicated that efficacy may be improved by refining application protocols and use rates (see e.g., Schneider, 2004).</td><td rowspan="3">Possibly, after further research that will optimize application methods, if no legal restrictions apply and where soil type is amenable</td></tr>
<tr><td>1,3-D + chloropicrin + metam-sodium</td></tr>
<tr><td>1,3-D + metam-sodium</td></tr>
</table>

**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
Muscador albus Strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

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

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

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 below

No alternatives are currently feasible in some orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of vines could be 20% (McKenry, 1999). Sites well-suited to 1,3-D should have efficacy similar to MB.

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?

For replant sites 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 problem. 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. Fallow has potential as a component of a management strategy and is being investigated especially when sites are first treated with an herbicide to kill remnant roots from previous plantings. Earlier research indicated that nematode control was short-lived (only up to 6 to 9 months) (McKenry, 1999). Rootstocks with resistance to the primary nematode pests are being investigated. Current research should help refine strategies for effective use of MeBr alternatives.

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 continue to be 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 effectively kill remnant roots and nematodes that feed on roots (e.g., Martin, 2003; McKenry, 2001). McKenry (1999) outlined several approaches through field studies that addressed MeBr alternatives for walnuts, grapes, stone fruit, and almonds. These included 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 MeBr is required.

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

The consortium has requested MeBr for "…pull out programs, age of vines, pests and new varieties", thus doubling the area to be replanted. The nomination has adjusted the request to account for growth. As with all replant sites, orchard replant problems for vineyards are a result of biological and environmental causes, and probably interactions of these factors. In situations with an identified pest, such as rootknot nematodes, there are promising resistant (or tolerant) rootstocks that may help alleviate the problem (e.g., Schneider et al, 2003, 2004); studies are ongoing to determine if fallow can reduce nematode populations in field trials and if VIF is useful in reducing emissions and increasing efficacy with lower rates.

Optimal pest management strategies need to be followed at time of orchard establishment. The 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 some 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 2008, for table grape and raisin vineyard replant, where alternatives are not effective, there is a critical need for MeBr for establishment of commercial operations.

CENTRAL CALIFORNIA WINEGROWERS—WINE GRAPES. PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

CENTRAL CALIFORNIA WINEGROWERS—WINE GRAPES. 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

CENTRAL CALIFORNIA WINEGROWERS—WINE GRAPES. 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
Central California Winegrowers—Wine 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 and chloropicrin, may be effective in reducing the effects of orchard replant disorder in vineyards, where there are no legal restriction, in light, sandy loam soils, and where there is acceptable soil moisture. For root knot and citrus nematode control, Inline and drip applied 1,3-D have showed good efficacy in research trials (Schneider et al., 2004). Rootstock "Harmony" has showed good efficacy against rootknot nematodes after six seasons, but poor efficacy against citrus nematodes (Schneider et al., 2004). In situations where soils are medium to heavy, or where township caps are applicable, MeBr is the only single compound that effectively targets root remnants from previous orchard trees. Strategies that include multiple techniques, such as use of herbicides and fallow and nematicides, have the potential to reduce pest problems in orchard replant. However, these combination techniques must first be tested and proven so as not to compromise orchard productivity. Some research suggests that long term fallow benefits diminished after four seasons (Schneider et al., 2004).

CENTRAL CALIFORNIA WINEGROWERS—WINE GRAPES. 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

As in stone fruit orchards, the typical practice of replanting vineyards with MeBr is to remove the old plantings 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 the early winter. When using MeBr growers may or may not fallow 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.

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE GRAPES. TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE 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.

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE 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 (counties include: Merced, San Joaquin, Madera, Fresno, Kings, Tulare, Kern, Stanislaus)											
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 vineyard											
PLANTING SCHEDULE	Planting occurs the year after fumigation											
KEY MARKET WINDOW:	Not applicable											

*For Fresno, California

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE 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) involves reducing pathogens (particularly 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, metam-sodium or 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.

Central California Grape Winegrowers—Wine Grapes. 12. Historic Pattern of Use of Methyl Bromide, and/or Mixtures Containing Methyl Bromide, for which an Exemption Is Requested

Central California Grape Winegrowers—Wine Grapes. Table 12.1 Historic Pattern of Use of Methyl Bromide

Years:	1998	1999	2000	2001	2002	2003
Area Treated all of California *(hectares)*	877	1088	429	92	123	42
	Hectares and Use Rate presented are for the treated strip.					
Ratio of Flat Fumigation methyl bromide use to strip/bed use if strip treatment is used	Strip (65% of a hectare is treated)	Strip (65% of a hectare is treated)	Strip (65% of a hectare is treated)	Strip (65% of a hectare is treated)	Strip (65% of a hectare is treated)	Strip (65% of a hectare is treated)
Amount of methyl bromide active ingredient used *(total kg)*	336,867	441,181	164,563	35,687	53,572	14,196
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)	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
Application rate [Active Ingredient] (kg/ha*)	384	406	384	387	435	339
Actual dosage rate of Active Ingredient in Treated Zone *(g/m^2)* *****	38.4	40.6	38.4	38.7	43.5	33.9

** For Flat Fumigation treatment application rate and dosage rate may be the same.*
Source of CA Usage data was T. Trout, USDA, ARS , CA Fumigant Use 2005.

Central California Grape Winegrowers—Wine Grapes. Part C: Technical Validation

Central California Grape Winegrowers—Wine Grapes. 13. Reason for Alternatives Not Being Feasible

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE 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 COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-D	Where soil moisture is acceptable and township caps are not instituted, 1,3-D may provide effective management of replant disorder in vineyards with light soils; usually more effective with chloropicrin.	With light soils, if no legal restrictions apply, usually in combination with chloropicrin
Metam-sodium	With current application technology does 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).	With light soils, if no legal restrictions apply; may be in combination with 1,3-D and chloropicrin
Chloropicrin	Where fungi are primary pest (requires addition of 1,3-D is nematodes are present)	In amenable soils, usually in combination with 1,3-D and/or metam-sodium
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	Some products have been tested (McKenry, appendix to consortium request for 2008 use season) but have not been sufficiently studied or effective to be considered alternatives. Products tested, or being tested, include: 30 products such as walnut tea, nicotinamide insecticide (Admire), Integrate (mineral extraction), Oxycom (peroxyacetic acide).	No
Sodium tetrathiocarbonate	This compound (Enzone) does not penetrate the old roots of the previous vineyard. Old roots 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. Generally this product is used in combination with other practices that will allow for successful replanting.	No
NON CHEMICAL ALTERNATIVES		

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE COST EFFECTIVE?
Fallow	Not sufficient alone; frequently done for 1 year regardless of fumigant that follows; may require 4-10 year fallow for some replant (Browne, 2002b) 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, however, economically difficult for grower to sustain (McKenry, 1999; McKenry et al., 1995).	No
Rootstock	Some rootstocks are available, such as Teleki 5C or Harmony, which can significantly reduce certain species of nematodes—but no multiple resistance. Used in combination with 1,3-D, significant reductions in rootknot and citrus nematodes have resulted in research tests (see Schneider et al., 2002, 2003; Ferris and Walker, 2002).	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, MeBr 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. Promising results from research trials indicated that efficacy may be improved by refining application protocols and use rates (see e.g., Schneider, 2004).	Possibly, after further research that will optimize application methods, if no legal restrictions apply and where soil type is amenable
1,3-D + chloropicrin + metam-sodium		
1,3-D + metam-sodium		

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

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE 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.

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE GRAPES. 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE 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
Muscador albus Strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

Central California Grape Winegrowers—Wine 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

Central California Grape Winegrowers—Wine Grapes. Table 16.1: Effectiveness of Alternatives – Replant Disorder (nematodes).

<table>
<tr><th>Key Pest: Replant disorder (Nematodes)</th><th></th><th colspan="6"></th><th></th></tr>
<tr><th>Methyl Bromide formulations and Alternatives
(include dosage rates and application method)</th><th># of Trials</th><th colspan="6">Disease (% or rating)</th><th>Citation</th></tr>
<tr><td>[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]</td><td>5 reps; grapes</td><td colspan="3">*Meloidogyne* spp. (#/100 cc soil) (trial planted and sampled 2001)

[1] 324a
[2] 0c
[3]290a
[4] 0c
[5] 8b</td><td colspan="3">*Tylenchulus semipenetrans* (#/100 cc soil) (trial planted and sampled 2001)
[1] 121a
[2] 0c
[3] 157a
[4] 0c
[5] 2bc</td><td>Schneider et al., 2002</td></tr>
<tr><td rowspan="3">[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]</td><td rowspan="3">5 reps; grapes</td><td colspan="6">*Meloidogyne* spp. per 100 cc soil (trial planted 1998, sampled 2001)</td><td rowspan="3">Schneider et al., 2002</td></tr>
<tr><td colspan="2">Thompson seedless rootstock</td><td colspan="2">Teleki 5C rootstock</td><td colspan="2">Harmony rootstock</td></tr>
<tr><td colspan="2">[1] 144ab
[2] 215a
[3] 145ab
[4] 1def
[5] 0.2ef
[6] 6cde</td><td colspan="2">[1] 261a
[2] 49b
[3] 190a
[4] 0.3c
[5] 0.6c
[6] 0.2c</td><td colspan="2">[1] 0.8a
[2] 0.0a
[3] 0.1a
[4] 0.0a
[5] 0.0a
[6] 0.0a</td></tr>
<tr><td rowspan="3">[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]</td><td rowspan="3">5 reps; grapes</td><td colspan="6">*Tylenchulus semipenetrans* per 100 cc soil (trial planted 1998, sampled 2001)</td><td rowspan="3">Schneider et al., 2002</td></tr>
<tr><td colspan="2">Thompson seedless rootstock</td><td colspan="2">Teleki 5C rootstock</td><td colspan="2">Harmony rootstock</td></tr>
<tr><td colspan="2">[1] 638a
[2] 352a
[3] 463a
[4] 0.4c
[5] 3c
[6] 6b</td><td colspan="2">[1] 301a
[2] 434a
[3] 342a
[4] 4b
[5] 1b
[6] 3b</td><td colspan="2">[1] 913a
[2] 1123a
[3] 723a
[4] 2b
[5] 6b
[6] 7b</td></tr>
</table>

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE GRAPES. TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

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 below

No alternatives are currently feasible in some orchard replant sites (i.e., those with medium to heavy soils) and/or where township cap restrictions apply. In these cases losses of vines could be 20% (McKenry, 1999). Sites well-suited to 1,3-D should have efficacy similar to MB.

CENTRAL CALIFORNIA GRAPE WINEGROWERS—WINE GRAPES. 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

For replant sites 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 problem. 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. Fallow has potential as a component of a management strategy and is being investigated especially when sites are first treated with an herbicide to kill remnant roots from previous plantings. Earlier research indicated that nematode control was short-lived (only up to 6 to 9 months) (McKenry, 1999). Rootstocks with resistance to the primary nematode pests are being investigated. Current research should help refine strategies for effective use of MeBr alternatives.

Central California Grape Winegrowers—Wine Grapes. 18. Are There Technologies Being Used to Produce the Crop which Avoid the Need for Methyl Bromide?

Tests continue to be 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 effectively kill remnant roots and nematodes that feed on roots (e.g., Martin, 2003; McKenry, 2001). McKenry (1999) outlined several approaches through field studies that addressed MeBr alternatives for walnuts, grapes, stone fruit, and almonds. These included 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 MeBr is required.

Central California Grape Winegrowers—Wine Grapes. Summary of Technical Feasibility

Approximately 7% (4656 ha) of the total area (66,800 ha) planted to central California wine grapes is replanted every year. Of this, approximately 15% (700 ha) is fumigated, and 60% of this area (420 ha) is fumigated with MB.

Optimal pest management strategies need to be followed at time of orchard establishment. The 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 some 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 2008, for wine grape vineyard replant, where alternatives are not effective, there is a critical need for MeBr for establishment of 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. Some alternatives, such as 1,3-D and chloropicrin, may be effective in reducing the effects of orchard replant disorder where there is low disease pressure or where there are no legal restriction 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, MeBr is the only single compound that can effectively target root remnants from previous orchard trees. Strategies that include multiple techniques, such as use of herbicides and fallow and nematicides, have the potential to reduce pest problems in orchard replant. However, these combination techniques must first be tested and proven so as not to compromise orchard productivity.

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

The typical practice of replanting orchards with MeBr 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 the early winter. Some growers routinely fallow land before replant.

When using 1,3-D + chloropicrin (the best alternative where conditions permit), the old trees are removed with 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.

MB is considered critical particularly in situations where walnut orchards are replanted with walnuts, as trees are more likely to be exposed to greater pest problems than planting walnuts in areas previously planted with other crops (McKenry, 1999; and personal communication, 2005). Walnuts are planted in rows varying in distance between rows from six to 12 meters, but fumigation may occur only in strips of 3 meters. 1,3-D may be strip or broadcast applied instead of MeBr in areas where there are no restrictions and soil conditions permit efficacy.

Market forces drive yearly replant when future demand is predicted to be high, more land will be planted, or replanted to new walnut orchards. New sites, rather than replanted walnut orchards, may comprise up to 75% of walnut growers new plantings. These areas generally would not be considered critical for MeBr use. Strip applications of 1,3-D, rather than MB, may comprise 50% of fumigated orchard land. Approximately 12% of growers do not fumigate.

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											
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 replace MeBr for the 2008 replant season.

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

Years:	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Area Treated *(hectares)*	348	89	139	201	180	182
	Hectares and Use Rate presented are for the treated strip.					
Ratio of Flat Fumigation methyl bromide use to strip/bed use if strip treatment is used	~75% replant is strip treatment	~75% replant is strip treatment	~75% replant is strip treatment	~75% replant is strip treatment	~75% replant is strip treatment	~75% replant is strip treatment
Amount of methyl bromide active ingredient used *(total kg)*	156,162	39,687	24,308	59,589	33,074	39,164
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*)*	shank injected	shank injected	shank injected	shank injected	shank injected	shank injected
Application rate [Active Ingredient] (kg/ha)	448	448	175	296	184	215

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 effective 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	No registration package has been received	No	Unknown
Propargyl bromide	No registration package has been received	No	Unknown
Iodomethane	Not registered in U.S.	Yes	Unknown
Muscador albus Strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

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

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 below

No alternatives are currently feasible in numerous 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 above are alternatives for sites where soils are amenable to 1,3-D and where township caps are not applicable. Sites well-suited to 1,3-D should have efficacy similar to MB.

CALIFORNIA WALNUT COMMISSION. 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

The use of 1,3-D is limited by township caps in the prime areas of walnut production in California (Central and Coastal valleys). In addition, 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 MeBr 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?

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, MeBr is critical to the establishment of the walnut orchard.

Some cultural practices can be instituted to reduce the effects of replant problems (McKenry, 1999). 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. 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 MeBr alternatives for walnuts, as well as grapes, stone fruit, and almonds. These include use of herbicides to kill remnant roots, use of fallow or rotation crops, 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 MeBr is required.

CALIFORNIA WALNUT COMMISSION. SUMMARY OF TECHNICAL FEASIBILITY

Where alternatives, such as 1,3-D and chloropicrin ,are not effective (e.g., sites with medium to heavy soils, and/or where township cap restrictions apply), MeBr will be critical to the healthy establishment of walnut orchards in 2008. However, approximately 75% of growers may use strip treatment and of those, 25-50% of this area currently may be treated with 1,3-D and not

MeBr (McKenry, 2005, personal communication). McKenry (1999) estimated 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. 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 chemical alternative to MB. However, the reality of California orchard locations precludes some 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 2008, for walnut replant where alternatives are not effective, there is a critical need for MeBr for establishment of 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 (affects ~25% of total growing area) is a disease complex comprising an interaction of pests (primarily nematodes) and environmental factors. Nematodes (affects 35-50% of total growing area): *Meloidogyne incognita* (root knot), *Pratylenchus vulnus* (root lesion), *Mesocriconema xenoplax* (ring), *Xiphinema americanum* (dagger); Bacteria: *Pseudomonas syringae* (canker) (affects 15% of total growing area); Fungi: Armillaria mellea (oak root fungus) (affects 5% of total growing area)	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 little virgin land is available, replant problems will occur in locations previously planted with almonds. Because of township caps (30% of area) and water moisture issues (65% of area), the best alternative, 1,3-D, is not available or effective as a replacement in many situations. Therefore, MeBr is considered critical for this industry. Alternatives, such as 1,3-D and chloropicrin, may be effective in reducing the effects of orchard replant disorder where there is low disease pressure or where there are no legal restriction 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, MeBr currently the product that has been sufficiently tested to effectively target root remnants from previous orchard trees. Strategies that include multiple techniques, such as use of herbicides, crop rotations, and fallow have the potential to reduce pest problems in orchard replant. Research is making progress in defining the most effective alternatives (e.g., Lampinen et al., 2004; Browne et al., 2004). However, these combination techniques must first be tested so as not to compromise orchard productivity.

ALMOND HULLERS & PROCESSORS ASSOCIATION. 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

The demand for almonds in the future is increasing, thus, after 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.

The typical practice of replanting orchards with MeBr 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 the early winter. When using fumigants, growers might fallow after tree removal and before replanting 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											
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?

Orchards replanted into previous orchard land (the typical situation in California) must reduce pathogen populations (mostly nematodes and fungi) and nutrient sources of old 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 effective 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 MeBr for almond replant for 2008. For sites that are not amenable to alternative chemical fumigants, MeBr is a key component of almond.

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

YEARS	1999	2000	2001	2002	2003	2004 [a]
AREA TREATED *(hectares)*	2,046	1,430	496	819	278	211
	Hectares and Use Rate presented are for the treated strip.					
RATIO OF FLAT FUMIGATION [b] METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Strip treatment (65% of hectare treated)	Strip treatment (65% of hectare treated)	Strip treatment (65% of hectare treated)	Strip treatment (65% of hectare treated)	Strip treatment (65% of hectare treated)	Strip treatment (65% of hectare treated)
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	703,401	497,810	174,502	217,032	85,375	64,088
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	shank injected	shank injected	shank injected	Shank injected	Shank injected	Shank injected
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha*)	344	348	352	265	307	304
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)* *****	34.4	34.8	35.2	26.5	30.7	30.4

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

[a] Data from preliminary estimates by California Department of Pesticide Regulation.

[b] Various methods are used depending on the particular situation; fumigation can be flat fumigation, strip, or even "by the hole" (for individual tree replacement; MeBr 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

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; currently not feasible in medium or heavy soils; usually more effective when formulated with chloropicrin; subject to township caps and specific moisture requirements. (e.g., Browne et al., 2003a). Promising results have been reported with 1,3-D/chloropicrin for treatment of replant disorder (Browne et al., 2003a, 2004)	Possibly, when able to optimize application methods
Chloropicrin	May perform acceptably alone when fungi are primary cause of orchard replant problem; for nematode causation, MeBr or 1,3-D is preferred. Promising results have been reported with some rates of chloropicrin for treatment of replant disorder (Browne et al., 2003a, 2004)	Possibly, when able to optimize application methods
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, or crop rotation	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). Some research suggests that short term rotations of some crops can reduce replant disorder, but large scale studies need to be completed (Browne et al., 2004).	No

Name of Alternative	**Technical and regulatory* reasons for the alternative not being feasible or available**	**Is the alternative considered cost effective?**
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" (Browne et al., 2003a). Initial results of research examining cover crops suggest reduction of replant disorder when wheat is incorporated into soil prior to planting nematode tolerant rootstocks (Browne, 2003b). However, this research must be continued, and results confirmed, before commercial application can be accepted.	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), and 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, MeBr 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. Promising results from research trials indicated that efficacy may be improved by refining application protocols and use rates (see e.g., Browne et al., 2003a, 2004).	Possibly, when able to optimize application methods, if no legal restrictions apply and where soil type is amenable
1,3-D + chloropicrin + metam-sodium		
1,3-D + metam-sodium		

** 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 effective 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	No registration package has been received	No	Unknown
Propargyl bromide	No registration package has been received	No	Unknown
Iodomethane	Not registered in U.S.	Yes	Unknown
Muscador albus Strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

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

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 below

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

Alternatives are used in most replant sites. MeBr is critical for 2008 for sites where conditions do allow effective use of alternatives (those with medium to heavy soils, and/or where township cap restrictions apply). In these cases losses of trees can be greater than 20% (McKenry, 1999). Sites well-suited to 1,3-D should have efficacy similar to MB.

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

1,3-D with chloropicrin is the primary alternative to MeBr in areas where it is effective (light soils, moisture less than 12% at 1.5 meters, high moisture above 30 cm) and allowed. Previously discussed alternatives are the primary ones continuing to be examined (e.g., Lampinen et al., 2004; Browne et al., 2004). 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) (McKenry, 1999). 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). Ongoing research (e.g., Lampinen et al., 2004; Browne et al., 2004) suggests that alternatives, including tolerant rootstocks, crop rotations, 1,3-D, chloropicrin, and VIF, have real potential as replacements for MB. However, most researchers warn that further research is necessary before protocols for commercial treatments can be devised and regulatory constraints (e.g., 1,3-D and VIF in California) will prevent uses in important areas.

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

A recent increase in demand for almonds has accelerated the rate of various orchards being replanted to almonds. To reduce MeBr use, however, growers have been switching from the traditional broadcast treatments to strip or single hole treatments. 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 concerning the management of orchard replant problem. Sound management practices provide the trees with the optimal environment to allow a productive and long-lived 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 MeBr alternatives for almonds, as well as walnuts, grapes, and stone fruit. These include use of herbicides to kill remnant roots, use of fallow, crop rotations, 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 MeBr is required. Early results, however, are promising (e.g., Browne et al., 2003b, 2004; Lampinen et al., 2004).

ALMOND HULLERS & PROCESSORS ASSOCIATION. SUMMARY OF TECHNICAL FEASIBILITY

Currently, no alternatives are feasible in approximately 7% of almond orchard replant sites (567 ha/8540 ha total replant). 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 can 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 precludes some growers from taking advantage of the material since either township caps or soil texture/moisture issues reduce efficacy or legal availability to 1,3-D. Therefore, in 2008, for almond replant where alternatives are not effective, there is a critical need for MeBr for establishment of commercial operations. Currently, research is being conducted examining non-fumigant treatments. Some non-chemical treatments have shown promise in small-scale research trials, such as use of crop rotation (Browne et al., 2003b, 2004). Continued studies will have to be conducted before these types of treatments are developed for commercial application.

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, crop rotation, strategic fertilization, water management, development of tolerant rootstocks, deep injection of chemicals—all will reduce the emissions of MeBr (or other 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 MeBr and reduce emissions.

19. TECHNIQUES THAT HAVE AND WILL BE USED TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS IN THE PARTICULAR USE

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 MeBr and other fumigants; reduction of MeBr 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. Although the cropping system of these orchards makes the use of MeBr cost effective, current research (e.g., Browne et al., 2004; Lampinen et al., 2004;

Schneider et al., 2004) is advancing the understanding of alternatives in orchard replant. This research will ultimately result in the development of protocols that will be adapted for commercial use.

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 MeBr use. Currently MeBr is used 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 MeBr 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 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 is considered a moderate loss, making the treatment economically feasible, providing there are no other losses.

Where 1,3 D is not permitted there are no effective nematicides. Trees that survive are not likely to be as healthy and could suffer yield losses. If a nematode infestation causes the death of trees, then replacement trees would also suffer the same infestation unless there use of an effective nematicide, or possibly several years of fallow.

An economic analysis was not done because most of the losses cannot be quantified since 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
- Delayed achievement of full yield potential
- Earlier loss of productivity of whole orchard

A number of soil pathogens and nematodes, many still poorly understood, occur 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, chloropicrin, and 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 MB, 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?

The development of technologies to improve efficacy of alternatives, such as deep injection methods, soil moisture management by improving drip technologies, use of fallow, crop rotation, tolerant rootstocks, and improved experience with chemical/non-chemical combinations. Even where MeBr is considered critical, an improvement in efficient delivery techniques will result in reduction of MeBr use requirements. Considering that this sector uses MeBr only once in the life of the orchard, use of alternatives to replace MeBr 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 MeBr alternatives for almonds, as well as walnuts, grapes, and stone fruit. These include use of herbicides to kill remnant roots, use of fallow and crop rotations, 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 MeBr is required. The consortia requesting MeBr are currently developing timelines for transition from MeBr to alternatives. These timelines should be presented in the very near future.

The amount of MeBr requested for research purposes is considered critical for the development of effective alternatives. Without MeBr 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 MeBr for 2008. This amount of MeBr is necessary to conduct research on alternatives and is in addition to the amounts requested in the submitted CUE applications.

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 MeBr 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 MeBr is considered critical, an improvement in efficient delivery techniques will result in reduction of MeBr use requirements, even though use of MeBr is only used 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. For further details regarding the transition plans for this sector please consult the national management strategy.

25. ADDITIONAL COMMENTS ON THE NOMINATION?

The U.S. Nomination for MeBr is for orchard replant areas where alternatives are not suitable, either because of legal restrictions or physical features, such as unacceptable soil type. The critical use exemption nomination for orchard replant has been reviewed by the U.S. government and meets the guidelines of The *Montreal Protocol on Substances That Deplete the Ozone Layer*. This use is considered critical in the designated areas because there are no effective alternatives or substitutes available. MeBr is critical in the orchards where 1,3-D will not be an effective treatment to orchard replant disorder, such as where orchards have medium to heavy soils, and/or township cap restrictions for 1,3-D. Under these circumstances MeBr is critical for use in 2008, and its absence will result in a significant burden for the orchard crop growers of California.

26. CITATIONS

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APPENDIX A. 2008 Methyl Bromide Usage Newer Numerical Index (BUNNI).

2008 Methyl Bromide Usage Newer Numerical Index - BUNNIE — **Orchard Replant**

January 24, 2006	Region		CA Stone Fruit - G&TFL	CA Raisin Grape - G&TFL	CA Walnut Commission	Sector Total or Average	Notes	Sector Total or Average	Notes
Dichotomous Variables	Strip or Bed Treatment?		Strip	Broadcast	Strip	Strip	Strip		
	Currently Use Alternatives?		Yes	Yes	Yes	Yes	-		
	Tarps / Deep Injection Used?		Deep	Deep	Deep	Deep	-		
	Pest-free Cert Requirements?		No	No	No	No	-		
Other Issues	Frequency of Treatment (x/ yr)		1x/ 22 years	1x/ 22 years	1x/ 40 years	1x/ 20 year	1x/ 25 years		*
	QPS Removed?		Yes	Yes	Yes	Yes	Yes		
Most Likely Combined Impacts (%)	Karst -1,3-D Limitation (%)		0%	0%	0%	0%	0%		
	100 ft Buffer Zones (%)		0%	0%	0%	0%	0%		
	Key Pest Distribution (%)		53%	46%	85%	45%	46%		
	Regulatory Issues (%)		3%	4%	6%	25%	4%		
	Unsuitable Terrain (%)		0%	0%	0%	0%	0%		
	Unsuitable Soil (%)		0%	0%	0%	0%	0%		
	Total Combined Impacts (%)		**54%**	**48%**	**86%**	**58%**	48%		
Most Likely Baseline Transition	(%) Able to Transition		0%	0%	0%	0%	0%		
	Minimum # of Years Required		0	0	0	0	0		
	(%) Able to Transition / Year		**0%**	**0%**	**0%**	**0%**	**0%**		
EPA Adjusted Use Rate (kg/ha)			336	310	280	330	350		
EPA Adjusted Strip Dosage Rate (g/m2)			34	31	28	33	35		
2008 Requested Usage	*Amount - Pounds*	*Pounds*	*2,430,000*	*682,243*	*500,000*	*455,000*	*202,800*	*4,270,043*	
	Area - Acres		*8,100*	*2,000*	*2,000*	*1,400*	*631*	*14,131*	
	Rate (lb/A)		*300.00*	*341.12*	*250.00*	*325.00*	*321.39*	*302*	
	Amount - Kilograms	Metric	**1,102,229**	**309,460**	**226,796**	**206,384**	**91,988**	**1,936,857**	
	Treated Area - Hectares		3,278	809	809	567	255	5,719	
	Rate (kg/ha)		336	382	280	364	360	339	
EPA Preliminary Value		**kgs**	**716,449**	**165,561**	**226,796**	**147,417**	**91,988**	**1,348,211**	
EPA Baseline Adjusted Value has been adjusted for:			MBTOC Adjustments, QPS, Double Counting, Growth, Use Rate/Strip Treatment, Light, Sandy Soil, and Combined Impacts						
EPA Baseline Adjusted Value		kgs	248,724	17,034	35,268	59,795	43,186	404,008	
EPA Transition Amount		kgs	-	-	-	-	-	-	
Most Likely Impact Value (kgs)		kgs	**248,724**	**17,034**	**35,268**	**59,795**	**43,186**	**404,008**	
		ha	**740**	**55**	**126**	**181**	**123**	**1,225**	
		Rate	**336**	**310**	**280**	**330**	**350**	**330**	
Sector Research Amount (kgs)			**1,658**	**2008 Total US Sector Nomination**				**405,666**	

1 Pound = 0.453592 kgs 1 Acre = 0.404686 ha

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

1. **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.
2. **Strip Bed Treatment** – Strip bed treatment is 'yes' if the applicant uses such treatment, no otherwise.
3. **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.
4. **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.
5. **Pest-free cert. Required** - This variable is a 'yes' when the product must be certified as 'pest-free' in order to be sold
6. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked

7. **<u>Frequency of Treatment</u>** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
8. **<u>Quarantine and Pre-Shipment Removed?</u>** – This indicates whether the Quarantine and pre-shipment (QPS) hectares subject to QPS treatments were removed from the nomination.
9. **<u>Most Likely Combined Impacts (%)</u>** – 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.
10. **<u>(%) Karst geology</u>** – Percent karst geology 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 geology.
11. **<u>(%) 100 ft Buffer Zones</u>** – 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.
12. **<u>(%) Key Pest Impacts</u>** - 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.
13. **<u>Regulatory Issues (%)</u>** - 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.
14. **<u>Unsuitable Terrain (%)</u>** – 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.
15. **<u>Cold Soil Temperatures</u>** – 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.
16. **<u>Total Combined Impacts (%)</u>** - 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 geology, 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 geology.
17. **<u>Most Likely Baseline Transition</u>** – Most Likely Baseline Transition amount was determined by the DELPHI process and was calculated by determining the maximum share of industry that can transition to existing alternatives.
18. **<u>(%) Able to Transition</u>** – Maximum share of industry that can transition
19. **<u>Minimum # of Years Required</u>** – The minimum number of years required to achieve maximum transition.
20. **<u>(%) Able to Transition per Year</u>** – The Percent Able to Transition per Year is the percent able to transition divided by the number of years to achieve maximum transition.
21. **<u>EPA Adjusted Use Rate</u>** - Use rate is the lower of requested use rate for 2008 or the historic average use rate or is determined by MBTOC recommended use rate reductions.
22. **<u>EPA Adjusted Strip Dosage Rate</u>** – The dosage rate is the use rate within the strips for strip / bed fumigation.
23. **<u>2008 Amount of Request</u>** – The 2008 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.
24. **<u>EPA Preliminary Value</u>** – The EPA Preliminary Value is the lowest of the requested amount from 2005 through 2008 with MBTOC accepted adjustments (where necessary) included in the preliminary value.
25. **<u>EPA Baseline Adjusted Value</u>** – The EPA Baseline Adjusted Value has been adjusted for MBTOC adjustments, QPS, Double Counting, Growth, Use Rate/ Strip Treatment, Miscellaneous adjustments, MBTOC recommended Low Permeability Film Transition adjustment, and Combined Impacts.

26. **EPA Transition Amount** – The EPA Transition Amount is calculated by removing previous transition amounts since transition was introduced in 2007 and removing the amount of the percent (%) Able to Transition per Year multiplied by the EPA Baseline Adjusted Value.
27. **Most Likely Impact Value** – The qualified amount of the initial request after all adjustments have been made given in total kilograms of nomination, total hectares of nomination, and final use rate of nomination.
28. **Sector Research Amount** – The total U.S. amount of methyl bromide needed for research purposes in each sector.
29. **Total US Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.