METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE FOR FRUIT, NUT AND FLOWER NURSERIES

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 Fruit, Nut and Flower Nurseries

NOMINATING PARTY CONTACT DETAILS

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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.

X Yes ☐ No

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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 (U. S.)

2. Descriptive Title of Nomination:

Methyl Bromide Critical Use Nomination for Preplant Soil Use for Fruit, Nut and Flower Nurseries

3. Crop and Summary of Crop System

This nomination is based on requests for critical use of MB by growers of raspberry, roses, and deciduous tree nursery stock. Nursery producers must be able to provide stock plants that are pest-free to allow the establishment of plantings that are of the highest initial quality and optimize the longevity of orchards or other producing plots. Nurseries provide plants used by commercial growers of fresh and processed raspberries, rose bushes, and such diverse fruit crops as apricots peaches, prunes, nectarines, cherries, plums, apples, pears, Asian pears (as well as ornamental pears), and nut crops such as almonds, walnuts, pistachios, pecans, and chestnuts. Approximately 95% of the trees are fruiting varieties sold to commercial producers (although residential consumers are also a market); the other 5% are ornamental types used for landscaping. Nurseries are concentrated in areas conducive to early plant growth—deciduous trees are primarily produced in California in the Sacramento and San Joaquin valleys in a Mediterranean climate, many large raspberry nurseries are located in eastern San Joaquin valley and western Washington where pest-free stock can be grown for markets in the cooler production areas of northern California and the Pacific Northwest.

Raspberry nurseries in the western U.S. provide raspberry stock to most of the growers in North America. Dry climates and soil type make these areas ideal for nurseries to provide high quality plant stock. Although there are relatively few raspberry nurseries, they provide all of the stock used by commercial growers and therefore, have a large impact on raspberry production overall. MB is used on a total area of approximately 200 hectares of field beds. However there is a large return in the benefits of certified pest-free stock to numerous commercial growers throughout the continent. The raspberry nursery industry uses flat fumigation techniques similar to that of the strawberry industry. Raspberry nursery stock is grown using a two year production cycle beginning with tissue culture and moving to foundation planting the first year. Winter dormant plants are replanted in commercial nurseries and harvested after one year.

Deciduous tree nurseries range from 15 to over 600 hectares in field beds. A typical operation in California ranges between 80 and 120 hectares. The climate and soil make this region an ideal area for tree nurseries (as well as a major fruit and nut producing region). While some nurseries concentrate on specific tree crops, most nurseries grow and sell a variety of different trees. Nursery stock is grown on a cropping system that includes crop rotation or cover cropping between tree production cycles; therefore, not all of the nursery is in tree production in a given year. The tree production cycle can be anywhere from a single year to several years depending on the type of tree crop being produced. Nursery production of trees takes from one to four years in the ground depending on the type being produced. Almonds take one year and walnuts take at least two years. Also, desired tree size determines how long it is grown in the nursery. The most common cycle is for the tree crop to be in the ground for either one or two years. A typical nursery cycle starts by digging the current tree crop (to be sold) then planting a cover crop for one or two years, followed by replanting with a tree crop. In order to prepare the ground for planting, the fields are disked, deep ripped, leveled, and then fumigated to meet certification standards set by the California Department of Food and Agriculture (CDFA, 1996). Generally the fumigation work is contracted out. A shank is used to apply a fumigation of 75% MB and 25% chloropicrin, typically at a rate of 340 kg per hectare. At the same time the majority of the nursery growers cover the treated area with a high barrier tarp. The fumigation is carried out around August and September, and planting begins in October, and may continue through January. The deciduous nurseries are subject to mandates set forth by the CDFA, that trees must be pest free.

Nursery roses are grown in open field plots. A typical crop rotation for a two year rose crop includes one year fallow, followed by one or two years of rotational crops, and then a two year rose crop. The two-year rose crop cycle begins with land preparation (removing the cover crop, deep cultivation, and fumigation with methyl bromide), followed by planting the rootstock and T-bud grafting. In late winter of the first year, the rootstock tops are removed. The rose crop matures by the second autumn and is then harvested. This cycle varies depending on the type of rose crop being produced (e.g., two-year roses, one-year minis and patio trees, or 18-month mini bushes).

METHYL BROMIDE NOMINATED

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)	NOMINATION AREA (HA)
2006	**63,225**	**203**

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

The U. S. Nomination is for areas within this sector where alternatives are not suitable, either because of legal restrictions, specific certification requirements, or physical features such as unacceptable soil moisture. Acreage subject to quarantine and pre shipment exemption (QPS) is not included. The deciduous fruit and nut tree nurseries in California, and the raspberry nurseries in the western states of California and Washington produce the majority of the stock for their respective industries; 95% of their sales are within California. The majority of the sales go to commercial fruit growers and the remaining trees are flowering varieties sold primarily to landscapers. The nematode species of concern in the nursery industry in Washington and California are *Meloidogyne* spp*., Pratylenchus* spp*., Trichodorus* spp*., Xiphinema* spp*.,* and *Criconemelia* spp. Various weed species and fungal pests are secondary pests in nurseries. Under California regulatory laws, nursery crops must be "free of especially injurious pests and disease symptoms" in order to qualify for a California Department of Food and Agriculture (CDFA) Nursery Stock Certificate for Interstate and Intrastate Shipments (CDFA, 1996). If a nursery grower uses MB or if allowed, 1,3-D, the crop is assumed to be "free of especially injurious pests and disease symptoms." However, if a grower fumigates with another alternative, or does not fumigate at all and there is history of nematode problems, the CDFA imposes nematode sampling requirements, which is at the expense of the grower. If nematodes are found stock will not be certified and grower will incur economic losses.

California nursery roses must meet certification requirements as well. Roses have deep roots, which require pest control to a depth of 1.5 meters. Rose growers may use 1,3-D if the following conditions are met: 1) the field has not been previously infested with nematodes, and 2) soil moisture levels are not higher than 12%, which implies that only sandy soils are approved. In addition, township caps in California restrict the amount of 1,3-D that can be used in a given area. This issue is especially important for nursery rose growers, as most production of this crop is concentrated in two townships where other crops that also use 1,3-D, such as almonds and carrots, are grown (Trout, 2001).

TABLE A.1: EXECUTIVE SUMMARY*

Region	*Western Raspberry Nurseries*	*California Deciduous Fruit & Nut Tree Growers*	*California Nursery Roses*
AMOUNT OF NOMINATION			
2006 Kilograms	10,952	31,903	20,167
Application Rate (kg/ha)	235	336	328
Area (ha)	47	95	61
AMOUNT OF APPLICANT REQUEST			
2006 Kilograms	49,879	224,528	209,975
Application Rate [Active Ingredient] (AI) (kg/ha)	253	336	337
Area (ha)	197	668	622
ECONOMICS FOR NEXT BEST ALTERNATIVE			
Technically Feasible Alternative (s)	**Best Alternative**	**Best Alternative**	**Best Alternative**
Yield Loss (%)	Not included as there is no technically feasible alternative.	Not included as there is no technically feasible alternative.	Not included as there is no technically feasible alternative.
Loss per hectare (US$/ha)			
Loss per kg Methyl Bromide (US$/kg)			
Loss as % of Gross Revenue (%)			
Loss as % of Net Revenue (%)			

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

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

Nurseries must provide stock that is pest-free in order to meet state mandated certification requirements for plant material (CDFA, 1996). Where allowed by township cap regulation and where soil type and moisture are acceptable, use of products with 1,3-D can provide an alternative to MB. Moisture restrictions for 1,3-D may be more limiting than township caps. Nurseries with heavy soils or moisture greater than 12% (especially common in clay soils at depths of 1 to 1.5 meters) are not likely to receive certification of nursery stock, because of the inability to effectively reduce populations of nematodes or pathogens. In these situations MB is critically needed. What is of primary importance is pest-free stock that is of sufficient quality to meet government standards and comply with standards for intra- and interstate plant transit.

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	TOTAL CROP AREA 2001 – 2002 AVERAGE (HA)	PROPORTION OF TOTAL CROP AREA TREATED WITH METHYL BROMIDE (%)
Western Raspberry Nurseries	Not available	Not available
California Deciduous Fruit & Nut Tree Growers	Not available	Not available

California Nursery Roses	Not available	Not available
NATIONAL TOTAL:	Not available	Not available

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

Nurseries must provide pest (pathogens) free stock and rely on MB for certification requirements.

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?

The critical need for MB exists for nurseries that are limited by state certification requirements or soil conditions making 1,3-D formulations unacceptable for many cases. Some areas with light, sandy soil-types, appropriate soil moisture, and no legal restrictions might be able to replace MB with 1,3-D alternatives but this is generally a limited area.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

TABLE 8.1. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION:	**Western Raspberry Nurseries**	**California Deciduous Fruit & Nut Tree Growers**	**California Nursery Roses**
YEAR OF EXEMPTION REQUEST	**2006**	**2006**	**2006**
KILOGRAMS OF METHYL BROMIDE	49,879	224,528	209,975
USE: FLAT FUMIGATION OR STRIP/BED TREATMENT	Flat Fumigation	Flat Fumigation	Flat Fumigation
FORMULATION *(ratio of methyl bromide/chloropicrin mixture)* TO BE USED FOR THE CUE	67:33	75:25	98:2
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(ha)*	197	668	622
APPLICATION RATE* *(kg/ha)* FOR THE **ACTIVE INGREDIENT**	253	336	337
APPLICATION RATE* *(kg/ha)* FOR THE **FORMULATION**	375	448	343
DOSAGE RATE* *(g/m^2)* OF **FORMULATION** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	37.5	44.8	34.3

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

9. SUMMARIZE ASSUMPTIONS USED TO CALCULATE METHYL BROMIDE QUANTITY NOMINATED FOR EACH REGION:

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

- The percent of regional hectares in the applicant's request was divided by the total area planted in that crop in the region covered by the request.
- Hectares counted in more than one application or rotated within one year of an application to a crop that also uses methyl bromide were subtracted. There was no double counting in this sector.
- Growth or increasing production (the amount of area requested by the applicant that is greater than that historically treated) was subtracted.
- Quarantine and pre-shipment (QPS) hectares is the area in the applicant's request subject to QPS treatments.
- Only the acreage experiencing one or more of the following impacts were included in the nominated amount: moderate to heavy key pest pressure, regulatory impacts, and unsuitable terrain.

TABLE A.2: 2006 SECTOR NOMINATION*

2006 (Sector) Nomination		Western Raspberry Nurseries	California Deciduous Fruit & Nut Tree Growers	California Nursery Roses
Applicant Request for 2006	Requested Hectares (ha)	197	668	622
	Requested Application Rate--AI (kg/ha)	253	336	337
	Requested Kilograms (kg)	49,879	224,528	209,975
CUE Nominated for 2006	Nominated Hectares (ha)	47	95	61
	Nominated Application Rate (kg/ha)	235	336	328
	Nominated Kilograms (kg)	10,952	31,903	20,167

2006 Sector Nomination Totals	Overall Reduction (%)	87%
	2006 U.S. CUE Nomination (kg)	63,225
	Research Amount (kg)	1506
	Total 2006 U.S. Sector Nominated Kilograms (kg)	**64,731**

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

WESTERN RASPBERRY NURSERIES PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

WESTERN RASPBERRY NURSERIES 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

WESTERN RASPBERRY NURSERIES. 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
Western Raspberry Nurseries	Primarily pathogens: *Phytophthora fragariae* var. *Rubi* (root rot), *Verticillium* spp. (wilt), others including *Pythium* spp., *Rhizoctonia* spp.	To meet certification requirements for sale of nursery stock within and outside of states.

WESTERN RASPBERRY NURSERIES 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

Raspberry nurseries in the western U.S. provide raspberry stock to most of the growers in North America. There are relatively few raspberry nurseries, yet they have a large impact on raspberry production overall. USDA organic standards specifically allow the use of nursery stock propagated using MB for organic production in recognition of the vital role vigorous planting stock plays in organic and integrated pest management systems. This further confirms that the use of MB in propagation nurseries reduces the need for MB, and other chemical inputs, in fruiting fields. MB use is concentrated within nurseries having a total area of approximately 200 hectares.

According to this consortium, "…fallow is part of the two-year cycle. The production of one acre of raspberry nursery is a 24-month process. It begins with land preparation in January of year 1. A cover crop is then grown during the winter, spring and early summer of year 1. In the summer the cover crop is incorporated into the soil and the land is prepared for fumigation. There is a brief fallow period in June of year 1 prior to fumigation. The field is fumigated in August of year 1. The planting beds are constructed in September of year 1. These beds lay "fallow" through the winter, until February of year 2. The planted crop will grow until harvest in November and December of year 2. Following the harvest we begin another cycle in January.

Although the nursery is a 24-month process, some land is fumigated each year to provide an annual supply of planting stock for our farmers. Therefore, the amount stated in the application refers to an annual usage."

WESTERN RASPBERRY NURSERIES. TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	WESTERN RASPBERRY NURSERIES
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	raspberry cane stock
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	2-3
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	1 year in foundation nursery, 1 year in commercial nursery. The raspberry nursery industry utilizes flat fumigation techniques similar to that of the strawberry industry. Raspberry nursery stock are grown using a two year production cycle beginning with tissue culture and moving to foundation nurseries the first year. Winter dormant plants are replanted in commercial nurseries and harvested after one year. Ten hectares of plants in a foundation nursery will serve to plant 100 hectares of a commercial nursery. A commercial nursery produces enough plants to provide 1200 hectares of commercial fields; therefore, pest infestation of nursery plants can impact significant areas of commercial fields.
SOIL TYPES: *(Sand, loam, clay, etc.)*	light, medium
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	once in 2-3 years
OTHER RELEVANT FACTORS:	None identified

WESTERN RASPBERRY NURSERIES. TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA zones 8a, 9a, 9b											
RAINFALL *(mm)*	16	72.1	17.3	0	trace	1.0	trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)*	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE						X						
PLANTING SCHEDULE												X

*For Fresno, California.

WESTERN RASPBERRY NURSERIES 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Soil moisture is an important determinant of capacity of 1,3-D efficacy (5). Moisture above 12% is common below 1 meter depth and reduction of 1,3-D nematicidal activity results at this moisture level; this is especially a problem with nurseries with heavier soils. It is critical that nurseries must control pests in the top 1 meter of soil because the plant roots extend to this depth. In addition, certification requirements make MB critical for many nurseries.

WESTERN RASPBERRY NURSERIES 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

WESTERN RASPBERRY NURSERIES. TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
AREA TREATED *(hectares)*	100	83	103	111	103	131
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 kilograms)*	25,485	21,313	26,671	26,937	24,188	30,570
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	shank injected, with tarp	shank injected, with tarp	shank injected, with tarp	shank injected, with tarp	shank injected, with tarp	shank injected, with tarp
APPLICATION RATE [ACTIVE INGREDIENT] **(kg/ha*)**	255	257	258	242	235	234
APPLICATION RATE [FORMULATION] **(kg/ha*)**	385	385	385	360	350	350
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	38.5	38.5	38.5	36.0	35.0	35.0

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

Western Raspberry Nurseries 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

WESTERN RASPBERRY NURSERIES. 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	not sufficiently effective to meet standards for pest-free nursery stock	no
1,3-dichloropropene (1,3-D)	in areas with moisture restrictions (e.g., >12% at 1-1.5 meters) (or under township caps) would not be able to meet standards for pest-free nursery stock; nurseries with no such restrictions should be able to use 1,3-D as an alternative	only where light soils and township caps allow use
metam-sodium	not sufficiently effective to meet standards for pest-free nursery stock	no
dazomet	Like metam-sodium is not an effective nematicide. The use of dazomet in combination with Telone was examined in a study submitted by the applicant. The study showed that although weed populations were suppressed, nematode populations were not controlled, causing stock to be commercially unacceptable. When dazomet was used in combination with 1,3-D, nematode populations were 15 times greater when compared to that of a dual application of 1,3-D. Importantly, dazomet does not allow for certification of the stock.	no

Non Chemical Alternatives		
containerized production	A field is planted with tissue culture plugs. The wide, flat planting beds allow these plants to grow laterally in all directions and to produce long straight roots. The nursery is watered using overhead irrigation, this creates optimal growing conditions over the entire surface area of the beds. Switching to containers would require much more land area to make up for the lack of efficiency in the system. In addition, there would be the cost of the containers, the cost of the planting mix which would have to be discarded after each use, and all the increased labor costs associated with a container based system. At the end of the growing season when plants are dormant they are mowed to about 20 cm long. The canes are chopped into small pieces and later they are incorporated into the soil to increase the organic matter. Then the beds are "lifted" and shaken, this removes soil from the plants and makes it easier to pick the plants up and place them in a box for transfer to the trimming operation. This system is very efficient because the crews can simply move up each row with a mower, then the lifter followed by several workers who transfer the plants into the bin for movement to the trimming operation. With field grown plants, plants are produced with long straight roots. The roots are trimmed from the canes at the trim shed and the trimmed roots are long enough to provide the root planting material used by the growers. Much of the land planted by growers comes from these trimmed roots. Generally, container-grown plants produce shorter or curved roots. New canes are produced from adventitious root buds, it is likely that any reduction in surface area would reduce the number and/or quality (size, strength) of these new adventitious canes. Nursery managers have observed that when raspberries are grown in pots, the south or hot side of the pot is not an optimal environment for growing raspberry roots. Pots are seen where there are no roots within a significant distance of the hot surface of the pot. This heat further reduces yields and increases water demands. Some of the largest nurseries are located in the eastern San Joaquin Valley of California where temperatures can reach over 40 C in the summer months. While the canes and aboveground plant parts can tolerate these temperatures, roots are not as large and healthy as what is produced in field systems.	no
Virtually Impermeable Film (VIF)	Might have role in reducing MB use rates while maintaining efficacy due to reduced emissions (Guillino et al., 2002; Martin, 2003). Ongoing studies may help assess value of VIF with MB and chemical alternatives.	no

biofumigation, solarization, steam heat, biological control, cover crops/mulches, crop rotation, flooding and water management, grafting/resistant rootstocks, organic amendments, sanitation, and resistant cultivars	Some of these alternatives are important components of an IPM system and are currently employed by the industry. These practices include field sanitation to reduce inoculum, crop rotation to reduce hosts, and attempts to breed resistance to pathogens. However, these alternatives will not meet requirements of CDFA for nursery stock certification either individually or in combinations. Use of flooding is not practical because of the topographic features of many production areas and requirements for excessive water use. The use of steam also requires extremely large quantities of water and is very slow and expensive to perform which would impact planting and production intervals for this industry. Use of solarization is not practical due to the depth of heating required to eliminate viable weed seed and environmental constraints at high altitude nurseries including high winds. Biological control currently is not a feasible alternative; studies done with biological control agents at Clemson University, South Carolina in conjunction with University of California-Riverside, have not shown sufficient promise to date to expect commercial use in the near future.	no
COMBINATIONS OF ALTERNATIVES		
(1,3-D) + chloropicrin	in areas with moisture restrictions (e.g., >12% at 1-1.5 meters) (or under township caps) would not be able to meet standards for pest-free nursery stock; nurseries with no such restrictions should be able to use 1,3-D as an alternative	only where light soils and township caps allow use
(1,3-D) + metam-sodium	in areas with moisture restrictions (e.g., >12% at 1-1.5 meters) (or under township caps) would not be able to meet standards for pest-free nursery stock; nurseries with no such restrictions should be able to use 1,3-D as an alternative	only where light soils and township caps allow use

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

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

WESTERN RASPBERRY NURSERIES - TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
None	Other than options discussed elsewhere, no alternatives exist for the control of the key pests when they are present in the soil and/ or afflict the below ground portions of raspberries.

WESTERN RASPBERRY NURSERIES - 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

WESTERN RASPBERRY NURSERIES. 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 has been requested	No	unknown
propargyl bromide	not registered in U.S., no registration has been requested	No	unknown
iodomethane	not registered in U.S.	Yes	unknown

WESTERN RASPBERRY NURSERIES - 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

As with other nursery commodities, yield is not the only (and possibly not the most important) factor in the production of raspberry nursery stock. What is of primary importance is pest-free stock that is of sufficient quality to meet government standards and comply with standards for intra- and interstate plant transit. While disease and other pest issues also occur with MB treated nurseries, the long time use of MB has given a level of experience with that compound that is only beginning to be assessed with alternatives. Consequently, the industry still has a critical need for MB until lessons gained from research with alternatives can be transferred to successful implementation in commercial nursery locations.

WESTERN RASPBERRY NURSERIES. TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – DISEASES

KEY PEST: DISEASES	AVERAGE DISEASE % OR RATING AND YIELDS IN PAST 3~5 YEARS				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF TRIALS	DISEASE (% OR RATING)	# OF TRIALS	ACTUAL YIELDS (T/HA)	CITATION
[1] MB (263 kg/ha) + chloropicrin (129 kg/ha) [2] chloropicrin (140 kg/ha) [3] no fumigation		no pests identified	12 reps	Runners/mother plant (strawberry) [1] 18.0a [2] 15.7b [3] 7.9c	Larson and Shaw, 2000
[1] MB (314 kg/ha) + chloropicrin (78 kg/ha) [2] chloropicrin (191 kg/ha) [3] chloropicrin (303 kg/ha) [4] no fumigation		no pests identified	4 reps	Runners/mother plant (strawberry) [1] 29.7a [2] 27.0a [3] 29.7a [4] 11.2b	Larson and Shaw, 2000
[1] MB (263 kg/ha) + chloropicrin (129 kg/ha) [2] chloropicrin (157 kg/ha) [3] chloropicrin (314 kg/ha) [4] no fumigation		no pests identified	24 reps	Runners/mother plant (strawberry) [1] 18.8a [2] 16.7b [3] 18.9a [4] 10.3c	Larson and Shaw, 2000
[1] MB (263 kg/ha) + chloropicrin (129 kg/ha) [2] chloropicrin (168 kg/ha) [3] chloropicrin (336 kg/ha) [4] 1,3-D (134 kg/ha) + chloropicrin (314 kg/ha) [5] 1,3-D (361 kg/ha) + chloropicrin (155 kg/ha) [6] no fumigation		no pests identified	12 reps (MB trt, 11 reps)	Runners/mother plant (strawberry) [1] 39.2a [2] 28.6bc [3] 33.8abc [4] 35.8ab [5] 33.0bc [6] 15.8d	Larson and Shaw, 2000

N.B.: some studies were with strawberry research, a crop with similar pest problems and because of the large size of the industry, a greater resource for research data.

WESTERN RASPBERRY NURSERIES. TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

More important than yield for raspberry nurseries, as well as other nurseries, is their dependence on certification of stock as 'pest-free' in order to meet state requirements to sell to commercial outlets.

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D (225 kg/ha)+ chloropicrin (123 kg/ha)	(fungal) pathogens (strawberry nursery)	2-15% (ref.: CDFA, 1996; Gullino et al., 2002)	14%
chloropicrin (300 kg/ha)	(fungal) pathogens (strawberry nursery)	5-16% (ref.: CDFA, 1996; Gullino et al., 2002)	9%
metam-sodium (350 kg/ha)	(fungal) pathogens (strawberry nursery)	13-57% (Gullino et al., 2002)	30%
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			9% plus certification issues

WESTERN RASPBERRY NURSERIES - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

Raspberry nurseries have spent $100,000 on research, including $20,000 on screening resistance for *Phytophthora* and *Verticillium*, and over $60,000 over the last decade studying various alternatives in the large Watsonville, California area. Studies are also ongoing to discover how application methods can improve efficacy of chemical alternatives such as 1,3-D and metam-sodium, and mixes of chemicals. Moisture constraints, both too much and too little, can reduce efficacy of effective chemicals such as 1,3-D, especially when soil textures are not optimal for their physical chemistry.

The use of virtually impermeable film (VIF) may offer a means of reducing MB use rates while maintaining efficacy and production goals . Work is being conducted to determine if this type of film is feasible in the U.S. from a technical standpoint (e.g., does it hold up physically in field conditions? can it be glued to acceptable specifications?, etc.) and economically feasible (e.g., cost of material, cost of application). However, the efficacy of VIF for U.S. agriculture may be different than that for Europe (Federal Register, 1998). There is also interest in examining the effects of certain fertilizer salts (e.g., ammonium thiosulfate, see Gan and Yates, 1998), which may act as barriers to volatile compounds (e.g., 1,3-D, MB) when applied to the soil surface, thus reducing emissions and improving efficacy.

WESTERN RASPBERRY NURSERIES 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

In some conditions alternative chemicals are used and research is ongoing to increase efficacy, as has been described above.

WESTERN RASPBERRY NURSERIES SUMMARY OF TECHNICAL FEASIBILITY

The raspberry nursery industry faces the same problems that other nurseries face in their need to produce nearly pest-free plant stock to their respective growers. Quality of stock plants may have a greater place in the requirements of the nursery managers than quantity since there can be an exponential increase in pest pressure when infested nursery stock is transferred to production fields. Therefore, the threshold for nurseries to manage pest problems is higher than might be for field production and critical need for effective pest management tools is paramount. Because locations of nurseries vary and soil, climate, and water conditions are variable, some alternatives may be acceptable substitutes for MB under low pest pressure. However, for the industry to succeed, currently there are no alternatives that will allow nurserymen to have confidence that their production goals can be met without MB, at least until research indicates that alternatives are feasible. As highlighted in two exhaustive meta-analyses studies (Larson and Shaw, 2000; Shaw and Larson, 2000), alternatives are not currently available to meet this sector's production needs.

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS. 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 Deciduous Fruit & Nut Tree Growers	**Nuts:** Nematodes—*Pratylenchus vulnus* (root lesion), *Meloidogyne* spp. (root knot), *Helicotylenchus dihystera* (spiral), *Xiphinema americanum* (dagger). **Stone Fruit:** Nematodes—*Helicotylenchus dihystera* (spiral), *Tylenchus mexicanus* (Tylenchus), *Tylenchorhynchus* spp. (stunt), *Trichodorus* spp. (stubby root)	Nurseries providing stock for orchards are required to provide the stock that is pest-free (and particularly nematode-free). MB is particularly effective in penetrating soil depths to reduce (frequently eliminate) nematode populations and therefore allow movement of nursery stock intra-and interstate. The alternative 1,3-dichloropropene is usually an effective nematicide, but it's use is restricted in California and may not be available to all the nurseries that require effective pest management tools to meet certification. Compounds producing methyl isothiocyanate (MITC) have been tested as possible alternatives (e.g., metam-sodium and dazomet) but nematode control was not sufficient beyond a short (6 month) time period, not long enough to meet certification requirements. Furthermore, because of strict legal requirements, only MB (and in some localities, 1,3-D) applications are acceptable for quarantine specifications. The goal in the orchard nursery industry is 99.9% control when sampled within 30-60 days after treatment, so certification can be met when stock is harvested 18 months later (McKenry, 2000). Generally, less than 98% control in the 30-60 day sampling period, will yield unacceptable stock plants. Field moisture is a carefully monitored factor. A site (e.g., walnut nursery in Davis, California) with silty clay loam over sandy loam or clay loam has moisture differential with the lighter textured soils holding more moisture (>12%), which can impede distribution of an alternative such as 1,3-D (McKenry, 2000) and make it ineffective. In California deciduous tree nurseries, approximately 30% have silt or clay loam soils requiring MB. The remaining 70% have sand or sandy loam soils. Approximately one half of these areas have a critical need for MB due to moisture requirements. Therefore, according to the applicant, approximately 65% of nursery soils in California have a critical need for MB. Township caps for 1,3-D may further limit the use of the best alternative.

California Deciduous Fruit & Nut Tree Growers - 11. (*i*) Characteristics of Cropping System and Climate

Deciduous tree nurseries range from 15 to over 600 hectares in size. The median operation in California ranges between 80 and 120 hectares. While some nurseries concentrate on specific tree crops, most nurseries grow and sell a variety of different trees. Nursery stock is grown on a cropping system that includes crop rotation or cover cropping between tree production cycles; therefore, not all of the nursery is in tree production in a given year.

California Deciduous Fruit & Nut Tree Growers - Table 11.1: Characteristics of Cropping System

Characteristics	California Deciduous Fruit & Nut Tree Growers
Crop Type: *(e.g. transplants, bulbs, trees or cuttings)*	nursery tree stock
Annual or Perennial Crop: *(# of years between replanting)*	perennial (1 to 2 years in nursery)
Typical Crop Rotation *(if any)* **and use of methyl bromide for other crops in the rotation:** *(if any)*	The tree production cycle can be anywhere from 1 year to several years depending on the type of tree crop. Nursery production of trees takes from 1-4 years. Almonds take one year, walnuts take at least two years. Also, desired tree size determines how long it is grown in the nursery. A typical cycle is for the tree crop to be in the ground for either 1 or 2 years. A typical nursery cycle starts by digging the current tree crop (to be sold) then planting a cover crop for 1 or 2 years, followed by replanting with a tree crop. Fields are disked, deep ripped, leveled, and then fumigated to meet certification standards set by the California Department of Food and Agriculture (CDFA, 1996). A shank is used to apply a fumigation of 75% MB and 25% chloropicrin, typically at a rate of 340 kg per hectare. The treated area is covered with a high barrier tarp. The fumigation is carried out around August and September, and planting begins in October, and may continue through January. The deciduous nurseries are subject to mandates set forth by the CDFA, that trees must be pest-free.
Soil Types: *(Sand, loam, clay, etc.)*	mostly sandy loam (also sandy clay loam, sandy loam, silt loam, clay loam); light soils (20%), medium (50%), heavy (30%)
Frequency of methyl bromide Fumigation: *(e.g. every two years)*	typically once in 3-5 years, depending on crop
Other relevant factors:	Nursery stock is inspected by county agricultural commissioners through the California Department of Food and Agriculture (CDFA). Stock must be "found free of especially injurious pests and disease symptoms" to qualify for the CDFA Nursery Stock Certificate for Interstate and Intrastate Shipments. MB is the only approved

CHARACTERISTICS	CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS
	fumigant for fields with a known history of nematodes, unknown history, or moderate to heavy clay content soils. While 1,3-D is a legally acceptable treatment in some areas, township restrictions and physical limitations (e.g., moisture greater than 12% in many soils reduces efficacy of 1,3-D) can reduce its use.

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA zones 8a, 9a, 9b											
RAINFALL *(mm)*	16	72.1	17.3	0	trace	1.0	trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)*	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE						X	X					
PLANTING SCHEDULE								X	X	X	X	

*For Fresno, California.

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Soil moisture content of greater than 12% reduces efficacy of 1,3-D. Soils that are so dry are unusual at 1.5 meters (the depth required to be nematode-free) (CDFA, 1996) especially with moderate to heavy subsoils. Approximately 65% of nurseries require MB to meet certification requirements (especially in wet years). Areas with light soils and dry conditions generally have good results from 1,3-D (where township caps allow its use) and combinations with chloropicrin and/or metam-sodium. (See Section 10, above.)

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

Approximately 30% of nursery soils are clay or silt loam and require MB, while one half of the remaining sand or sandy loam soils do not meet the moisture requirements of less than 12% for use of 1,3-D. Therefore, approximately 65% of the nurseries have a critical need for MB. MB, 1,3-D and some solarization treatments are the only approved fumigants for treatment of nematodes in nurseries to meet California Department of Food and Agriculture standards. However, MB is critical to the production of nematode-free stock where 1,3-D is not feasible (approximately 65% of the area) because of incompatible soil moisture or soil type, or township cap limitations.

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
AREA TREATED *(hectares)*	652	632	698	639	633	not reported
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat Fumigation	Flat Fumigation	not reported
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	215,592	201,208	222,433	207,755	212,689	not reported
FORMULATIONS OF METHYL BROMIDE *(e.g. methyl bromide 98:2; methyl bromide /chloropicrin 70:30)*	75:25	75:25	75:25	75:25	75:25	not reported
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	shank injected with tarp	shank injected with tarp	shank injected with tarp	shank injected with tarp	shank injected with tarp	not reported
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha*)	331	319	318	325	336	not reported
APPLICATION RATE [FORMULATION] (kg/ha*)	441	425	425	433	448	not reported

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	44.1	42.5	42.5	43.3	44.8	not reported

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

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS. PART C: TECHNICAL VALIDATION

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS. 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		
dazomet, metam-sodium	Not effective nematicides. The use of dazomet in combination with Telone was examined in a study submitted by the applicant. The study showed that although weed populations were suppressed, nematode populations were not controlled, causing stock to be commercially unacceptable. When dazomet was used in combination with 1,3-D, nematode populations were 15 times greater when compared to that of a dual application of 1,3-D. Importantly, dazomet and metam-sodium will not allow for certification of the seedling without additional expense to the grower.	no
NON CHEMICAL ALTERNATIVES *STANDARD NURSERY PRACTICES SEEK TO REDUCE PEST PROBLEMS WITH GENERAL IPM PROGRAMS. HOWEVER, FOR THIS SECTOR NON-CHEMICAL ALTERNATIVES ARE NOT TECHNICALLY FEASIBLE BECAUSE OF CALIFORNIA CERTIFICATION REQUIREMENTS FOR NEMATODE-FREE PLANT STOCK AND TOWNSHIP CAPS AND BUFFER ZONE RESTRICTIONS.*		
Virtually Impermeable Film (VIF)	Might have role in reducing MB use rates while maintaining efficacy due to reduced emissions (Gullino et al., 2002; Martin, 2003). Studies are being conducted to assess film with MB and chemical alternatives.	no

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Biofumigation, solarization, steam heat, biological control, cover crops/mulches, crop rotation, flooding and water management, grafting/resistant rootstocks, organic amendments, sanitation, and resistant cultivars.	Some of these alternatives are important components of an IPM system and are currently employed by the industry. These practices include field sanitation to reduce inoculum, crop rotation to reduce hosts, and attempts to breed resistance to pathogens. However, these alternatives will not meet requirements of CDFA for nursery stock certification either individually or in combinations. Use of flooding is not practical because of the topographic features of many production areas and requirements for excessive water use. The use of steam also requires extremely large quantities of water and is very slow and expensive to perform which would impact planting and production intervals for this industry. Use of solarization is not practical due to the depth of heating required to eliminate viable weed seed and environmental constraints at high altitude nurseries including high winds. Biological control currently is not a feasible alternative; studies done with biological control agents at Clemson University, South Carolina in conjunction with University of California-Riverside, have not shown sufficient promise to date to expect commercial use in the near future.	no
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin	Only feasible in limited areas. In most affected areas, especially those with moderate to heavy soils or subsoils, moisture at depths of 1.5 meters (depth required for nematode-free certification) (CDFA, 1996) is usually >12%, which significantly reduces efficacy of 1,3-D. This situation would occur in at least 65% of affected soils. While some research trials indicate that these alternatives can be effective in nematode control in certain nursery areas (e.g., Schneider et al., 2002b; Westerdahl et al., 2002), for the nursery sector as a whole the certification standard is so high that only limited nursery areas will be able to use 1,3-D/mixes if certification requirements are to be satisfied. Therefore, there is still a critical need for the use of MB for production of nursery-grown orchard stock. According to one calculation (Martin et al., 2003), overall in California 33% of the area previously fumigated with MB could not be treated with 1,3-D due to current township caps, regardless of efficacy. Caps, combined with limitations due to unacceptable soil moisture make alternatives unlikely to replace the critical need of MB for at least a large portion of this nursery sector.	no
1,3-D + chloropicrin + metam-sodium		no
1,3-D + metam-sodium		no
1,3-D + dazomet		no

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

California Deciduous Fruit & Nut Tree Growers - 14. List and Discuss Why Registered *(and Potential)* Pesticides and Herbicides Are Considered Not Effective as Technical Alternatives to Methyl Bromide:

California Deciduous Fruit & Nut Tree Growers - Table 14.1: Technically Infeasible Alternatives Discussion

Name of Alternative	Discussion
None	Other than options discussed elsewhere, no alternatives exist for the control of the key pests when they are present in the soil and/ or afflict the below ground portions of deciduous fruit and nut trees.

California Deciduous Fruit & Nut Tree Growers - 15. List Present *(and Possible Future)* Registration Status of Any Current and Potential Alternatives:

California Deciduous Fruit & Nut Tree Growers - 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 has been requested	No	unknown
propargyl bromide	not registered in U.S., no registration has been requested	No	unknown
iodomethane	not registered in U.S.	Yes	unknown

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - 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 DECIDUOUS FRUIT & NUT TREE GROWERS. TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – NEMATODES.

KEY PEST: NEMATODES			
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	**# OF TRIALS**	**DISEASE (% OR RATING)**	**CITATION**
[1] untreated [2] MB (568 kg/ha) [Tarped] [3] 1,3-D (272 kg/ha) + chloropicrin (155 kg/ha) [Telone 35, Untarped] [4] 1,3-D (312 kg/ha) + chloropicrin (177 kg/ha) [Telone 35, Tarped] [5] chloropicrin (400 kg/ha) [Untarped] [6] chloropicrin (455 kg/ha) [Tarped]	mean of 6 reps. in vine, tree, berry field nursery trial	**Rootknot nematode population/cc soil sampled at 120-150 cm depth** [1] 21.3a [2] 0b [3] 0b [4] 2.2b [5] 0b [6] 0b	Schneider et al., 2002b
[1] untreated [2] MB (285 kg/ha) [Tarped, Fall] [3] MB (285 kg/ha) [Tarped, Spring] [4] metam-sodium (425 kg/ha injected + 329 kg/ha overlay rotovate) [Tarped] [5] metam-sodium (425 kg/ha injected + 329 kg/ha overlay rotovate) [Untarped]	4 reps, trial Malin, Oregon, 2001; loamy sand; moisture 2% at surface, 19% at 1 meter)	**Percent control of citrus nematode (bioindicator) compared to untreated:** [2] 93% (some survival at 80 cm depth) [3] 93% (some survival at 80 cm depth) [4] 81% (survival at 65-80 cm depth) [5] 73% % (survival below 5 cm depth)	Westerdahl et al., 2002
[1] untreated [2] MB (455 kg/ha) [shank, Tarped] [3 1,3-D (445 kg/ha) [drip Telone II EC; Tarped]	4 reps, artificially inoculated soils with rootknot and citrus nematodes to depths of 30 cm, 90 cm, and 150 cm	**Percent control of citrus and rootknot nematodes compared to untreated:** [2] 100% (at all depths) [3] significant nematode populations at 150 cm; control at 30 cm was “excellent”	Schneider et al., 2003a

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

Yield is not a sufficient measure of critical need for MB for this industry or to determine economic feasibility in this sector since the issue is one of constraints due to the quality of the plant stock and the ability to have such stock certified as pest-free in order to sell to commercial users.

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D (312 kg/ha)+ chloropicrin (177 kg/ha)	nematodes	Not applicable	Not applicable
1,3-D (312 kg/ha) +chloropicrin (177 kg/ha) + metam-sodium (350 kg/ha)	nematodes	Not applicable	Not applicable
1,3-D + metam-sodium (350 kg/ha)	nematodes	Not applicable	Not applicable
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			Not applicable; certification issues

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

Between 1999 and 2000, the California fruit, vine, and nut industries have spent $378,467 on numerous research projects. From 2002-2003, $262,002 were granted to researchers by this industry. In addition, an equal amount has been granted by government and universities.

Research for MB alternatives has been conducted in earnest by the nursery industry since at least 1990, initially to find alternatives to 1,3-D, whose registration had been cancelled (Martin, 2003). Upon reinstatement in 1994, studies began to examine1,3-D formulations and mixes that could provide acceptable nematode control under conditions (especially critical moisture conditions) common to commercial nursery sites that would meet certification requirements and reduce or replace the use of MB (Martin, 2003; McKenry, 2000). Successful treatment with 1,3-D depends on enough surface moisture to allow penetration into the soil, but less than 12% moisture (difficult to achieve with heavier soils at depths over 1 meter). Consequently, while experiments are continuing, the “learning curve” is significant, and the critical need for methyl bromide exists in many nurseries, for technical limitations of soil-type and moisture, and township limitations of 1,3-D (CDFA, 1996; Martin, 2003).

Studies with new emulsifiable formulations of 1,3-D and chloropicrin , such as Inline may improve efficacy by removing technical limitations of shank injected 1,3-D. However, township caps, buffer zones, and limitations due to physical characteristics of soils are still important issues to successful nursery production.

California Deciduous Fruit & Nut Tree Growers - 18. Are There Technologies Being Used to Produce the Crop which Avoid the Need for Methyl Bromide?:

1,3-D can be effective in some situations, where soil, moisture, and legal caps are not limiting.

California Deciduous Fruit & Nut Tree Growers - Summary of Technical Feasibility

The primary concern for the deciduous tree nursery industry is their need to have their stock certified according to the strict standards set for inter-and intrastate movement of plant material. According to the government oversight authorities (CDFA, 1996) MB, and in certain cases, 1,3-D, are the only treatments that are recognized as able to satisfactorily control nematodes, the primary pest of deciduous tree nurseries. The issue with critical use of MB is the circumstance of many nurseries whose soil type or other conditions (e.g., township caps, buffer zone limitations) precludes the use of 1,3-D formulations. Consequently, MB is still considered a critical tool for this industry's ability to maintain its production and market goals. In those areas with light soils and no legal restrictions, 1,3-D formulations may suffice to meet certification requirements.

California Nursery Roses - Part B: Crop Characteristics and Methyl Bromide Use

California Nursery Roses - 10. Key Diseases and Weeds for which Methyl Bromide Is Requested and Specific Reasons for this Request

California Nursery Roses - Table 10.1: Key Diseases and Weeds and Reason for Methyl Bromide Request

Region where methyl bromide use is requested	Key disease(s) and weed(s) to genus and, if known, to species level	Specific reasons why methyl bromide is needed
California Nursery Roses (primarily in the San Joaquin Valley – 55 to 65% of U.S. rose plant production is located around Wasco, Kern County, CA)	Root knot nematode (*Meloidogyne hapla*); lesion nematode (*Pratylencus penetrans*); pin nematode (*Paratylenchus hamatus*); *Verticillium dahlia*; *Pythium* spp.; *Agrobacterium tumefaciens*; weeds (including *Cyperus* spp.)	California Nursery Stock regulations state that nursery stock must be commercially clean with respect to established pests of general distribution. County agricultural officials may certify a crop based on the completion of a prescribed fumigation regime, such as the use of methyl bromide (CDFA, 1996). In addition, control must to a depth of 1.5 meters, and methyl bromide is uniquely suited for this situation.

California Nursery Roses - 11. (*i*) Characteristics of Cropping System and Climate

California Nursery Roses - Table 11.1: Characteristics of Cropping System

Characteristics	California Nursery Roses
Crop Type: *(e.g. transplants, bulbs, trees or cuttings)*	Transplant production
Annual or Perennial Crop: *(# of years between replanting)*	Perennial (see below)
Typical Crop Rotation *(if any)* **and use of methyl bromide for other crops in the rotation:** *(if any)*	Typically, crop rotation for a two year rose crop includes one year fallow, followed by one or two years of rotational crops, and then a two year rose crop. This rotation varies depending on the type of rose crop being produced (i.e., two-year roses, one-year minis and patio trees, or an 18-month mini bush).
Soil Types: *(Sand, loam, clay, etc.)*	Medium soil with 0 to 2% organic matter.
Frequency of methyl bromide Fumigation: *(e.g. every two years)*	Once every 4 to 5 years (a typical grower fumigates and plants approximately 20-25% of the acreage he or she controls each year).
Other relevant factors:	The perennial nature of the crop requires pest control to a depth of 1.5 meters. Certification requires commercially clean stock. In tree nursery production, there must be 99.9% nematode control in the first 30 to 60 days to meet this requirement (McKenry, 2000).

CALIFORNIA NURSERY ROSES - 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 Zone 9a											
RAINFALL *(mm)**	16.0	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				Land prep	X							
PLANTING SCHEDULE								X	X			
KEY MARKET WINDOW												

+ The planting and fumigation schedule are for 1 year roses. The schedules vary for other rose crops.
*Data for Jan-Aug, 2003 and Sep-Dec 2002 for Fresno, California.

For a particular parcel of land, the overall cycle is shown below (Table 11.3). This schedule will vary depending on the type of rose crop grown. For example, two year rose crops would be grown an additional year before harvesting.

CALIFORNIA NURSERY ROSES - TABLE 11.3 MULTI-YEAR ROSE CROP SCHEDULE

	SPR*	SUM	FAL	WNT	SPR	SUM	FAL	WNT	SPR	SUM	FAL	WNT	SPR	SUM	FAL	WNT
FUMIGATION SCHEDULE		X														
PLANTING SCHEDULE			X													
HARVEST SCHEDULE							X	X								
FALLOW									X	X	X	X				
COVER CROP	X												X	X	X	X

* spr = spring; sum = summer; fal = fall; wnt = winter

CALIFORNIA NURSERY ROSES – 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

No characteristics were identified that would prevent the uptake of any relevant alternative.

CALIFORNIA NURSERY ROSES - 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

CALIFORNIA NURSERY ROSES - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
AREA TREATED *(hectares)*	611	600	609	647	645	584
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 kilograms)*	205,613	201,803	204,933	217,588	219,938	183,396
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	98:2	98:2	98:2	98:2	98:2	98:2
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	Shanked 10 inches deep and tarped	Shanked 10 inches deep and tarped	Shanked 10 inches deep and tarped	Shanked 10 inches deep and tarped	Shanked 10 inches deep and tarped	Shanked 10 inches deep and tarped
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha*)	336	336	336	336	341	314
APPLICATION RATE [FORMULATION] (kg/ha*)	343	343	343	343	343	343
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	34.3	34.3	34.3	34.3	34.3	34.3

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

CALIFORNIA NURSERY ROSES - PART C: TECHNICAL VALIDATION

CALIFORNIA NURSERY ROSES - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

CALIFORNIA NURSERY ROSES – 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-Dichloropropene	1,3-D is technically feasible in some situations, such as areas with sandy soils where the soil moisture can be reduced to 12 percent or less. According to California certification regulations, this alternative is not acceptable on soils known to be infested with nematodes (CDFA, 1996). Nematodes were not controlled at deeper depths in several studies. In a tree nursery study, nematodes were controlled at deeper depths with 1,3-D and its combinations. Control is comparable to methyl bromide in sandier soils because the soil moisture can be reduced to 12 percent or less (McKenry, 2000; McKenry, 2001). In a nursery rose trial, preliminary results demonstrate that only methyl bromide can control the entire nematode complex to the depth required (Schneider et al, 2002a). Results with 1,3-D are inconsistent, as other studies have shown control of nematodes with 1,3-D plus chloropicrin. 1,3-D plus chloropicrin did not control *Verticillium dahliae, Pythium* spp., or weeds in a rose trial (Karlick et al, 1998). Township caps are in place for 1,3-D. Almost all of California nursery growers are located within two townships in one county, and rose growers compete for the use of 1,3-D with growers of almonds, carrots, and other crops for this acreage (Trout, 2001). Buffer zones of 300 feet apply in California, reducing the amount of acreage that can be treated with 1,3-D.	No
Dazomet (Basamid)	Dazomet is not a technically feasible alternative because it does not adequately control target pests at deep enough levels in the soil in a rose trial (Schneider et al, 2002a). Dazomet and metam-sodium are both MITC generating substances and the inability of MITC from metam sodium to penetrate deep enough at the maximum allowed application rate is likely to also be true for dazomet.	No.
Metam-sodium	Metam-sodium is not a technically feasible alternative alone because it results in nursery rose shipments that are not certifiable. Research indicates that a non-certifiable crop occurs because metam-sodium did not move deep enough into the soil (at the 1.2 to 1.5 meter depth metam sodium did not control the nematodes) (Schneider et al, 2002a). Metam sodium provides inconsistent control (McKenry, 1999). Metam sodium also does not control *Pythium* spp. (Karlick et al, 1998).	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		
Solarization, Steam Sterilization, Biological Control	Under proper climatic conditions, solarization will control pests to a depth of 30 cm. This depth is far short of the 1.5 meters required for nursery roses (Pizano, 2001; Braun and Supkoff, 1994). In addition, these treatments would not allow a nursery rose grower to meet the California certification standard (CDFA, 1996).	No.
General IPM, Grafting/Resistant Rootstock/Plant Breeding, Physical Removal/Sanitation, Resistant Cultivars	Although these "not in-kind" alternatives are being used by nursery rose growers to reduce pest pressure, in general, by themselves and in combination, each have not been successful at achieving adequate pest control. In addition, these "not in-kind" alternatives alone would not allow a nursery rose grower to meet the California certification standard.	No.
Substrates/Plug Plants	Use of "plug plants" is not technically feasible for nursery growers because virtually all production is by grafting onto resistant rootstock, not by the use of cuttings. Substrate production in CA is technically infeasible for two reasons. One, roses are a deep rooted crop. Rose rootstock is grown for 18 months (called 1-year by the market) or 2 years resulting in root systems of 3 feet. The containers do not allow full development of the root systems which then reduces the rigor/vigor of the plant. Second, production in CA is technically infeasible based on the scale of production. Plants are spaced 6" apart on thousands of acres. Research would need to be conducted to determine the commercial feasibility of a change of this magnitude to a soilless culture.	No.
COMBINATIONS OF ALTERNATIVES		
1,3-Dichloropropene + chloropicrin and/or metam sodium	See the regulatory and technical limitations for 1,3-Dichloropropene above.	No

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

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

CALIFORNIA NURSERY ROSES – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
Iodomethane + chloropicrin	Iodomethane plus chloropicrin appears to be the best solution to replace the use of methyl bromide. Studies have shown the control of all nematode genera found on roses at a depth of 1.5 meters (Schneider et al, 2002a). This treatment is likely to require some additional weed control measures, but does provide weed control that is comparable to methyl bromide in many cases. This alternative is not registered.

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

CALIFORNIA NURSERY ROSES – 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:
Iodomethane	Not registered	Yes	Unknown
Sodium azide	Not registered	Registration package not submitted	Unknown
Propargyl bromide	Not registered	Registration package not submitted	Unknown

CALIFORNIA NURSERY ROSES - 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

Research on MB alternatives for the nursery rose industry is described. Growers need to achieve nematode control to a depth of 1.5 meters to meet regulation requirements. Other pests, such as *Verticillium*, *Pythium*, and weeds also need to be controlled. Some studies on tree nurseries have been included since growers must meet the same certification requirement for stock. Not all studies contained yield information, pest pressure, and comparison to methyl bromide or statistical analyses.

Evaluation of Alternatives to Methyl Bromide for Roses (Schneider et al, 2002a; Schneider et al, 2003b). Preliminary data from a study by the Agricultural Research Service, USDA were submitted. Nematodes were sampled in 250 cc soil at the following depths: 0-12 inches (0-0.3 meters), 12-24 inches (0.3-0.6 meters), 24-36 inches (0.6-0.9 meters), 36-48 inches (0.9-1.2 meters), and 48-60 inches (1.2-1.5 meters). Stunt nematode (*Tylenchorhynchus spp.*) was predominantly found at the site, but populations of root knot nematode (*Meloidogyne spp.*) and stubby root nematode (*Paratrichodorus spp.*) were also present at low levels. The only alternatives that provided control to the lowest depth (1.2 to 1.5 meters) were methyl bromide and iodomethane drip applications, although these results were not statistically different from many of the other alternatives. The following year, additional data were collected, including weed ratings. Methyl bromide had the best weed rating of all the alternatives. Additional data, including summer/fall nematode and fungal populations in the soil and plant quality at harvest, are yet to be collected. The results are shown in Tables 16.3 and 16.4.

Jackson and Perkins Fumigant Tests, 2003. Preliminary data submitted by Jackson and Perkins Operation, Inc. showed yield losses of 2–8% for metam-sodium (Vapam HL, 701 L/ha), yield losses of 5% for 1,3-D (Telone II, 309 L/ha), and for methyl bromide (336 kg/ha) yield gains of up to 10% to yield losses of 6% The data submitted gave yields compared to historic yields for numerous rose varieties. The first year results indicated that there was no nematode pressure in the trials. There was no statistical analysis on the results.

Other studies submitted were conducted on orchard and vineyard crops. Some the results are included in the tables below. These studies demonstrate that the alternative do not provide the same level of nematode control as methyl bromide to the depth required.

California Nursery Roses – Table 16.1: Effectiveness of Alternatives – Nematodes

Key Pest: Nematodes	Average disease % or rating and yields in past 3~5 years		
Methyl Bromide formulations and Alternatives	# of Replications	Total # Nematodes at a depth across all replicates (The results have been added across the 4 replicates – there is no statistical analysis on these results).	
		Depth	# of Nematodes
MB + CP (75/25) 535 lb/ac (599 kg/ha), tarped	4	0-1 feet (0-0.3 meters)	0
		1-2 feet (0.3-0.6 meters)	0
		2-3 feet (0.6-0.9 meters)	0
		3-4 feet (0.9-1.2 meters)	2
		4-5 feet (1.2-1.5 meters)	15
Dual application Telone C-35 @ 65 gpa (608 L/ha) or approx. 650 lb/acre (728 kg/ha)	4	0-1 feet (0-0.3 meters)	2
		1-2 feet (0.3-0.6 meters)	1
		2-3 feet (0.6-0.9 meters)	0
		3-4 feet (0.9-1.2 meters)	2
		4-5 feet (1.2-1.5 meters)	47
1,3-D (330 lb/ac (370 kg/ha)) then metam sodium drench (110 lb/ac (123 kg/ha))	4	0-1 feet (0-0.3 meters)	5
		1-2 feet (0.3-0.6 meters)	0
		2-3 feet (0.6-0.9 meters)	1
		3-4 feet (0.9-1.2 meters)	40
		4-5 feet (1.2-1.5 meters)	103
1,3-D (330 lb/ac (370 kg/ha)) then Basamid drench (200 lb/ac (224 kg/ha))	4	0-1 feet (0-0.3 meters)	0
		1-2 feet (0.3-0.6 meters)	0
		2-3 feet (0.6-0.9 meters)	0
		3-4 feet (0.9-1.2 meters)	2
		4-5 feet (1.2-1.5 meters)	16
Non-treated check	4	0-1 feet (0-0.3 meters)	98
		1-2 feet (0.3-0.6 meters)	455
		2-3 feet (0.6-0.9 meters)	416
		3-4 feet (0.9-1.2 meters)	836
		4-5 feet (1.2-1.5 meters)	216

McKenry, 2000 (this study was conducted on tree nurseries).

CALIFORNIA NURSERY ROSES – TABLE 16.2: EFFECTIVENESS OF ALTERNATIVES – PHYTOPHTHORA

KEY PEST: PHYTOPHTHORA CITRICOLA	AVERAGE DISEASE % OR RATING AND YIELDS IN PAST 3~5 YEARS		
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF REPLICATIONS	TOTAL NUMBER OF COLONIES FORMED OUT OF 10 INOCULUM PIECES PLATED AT CERTAIN DEPTHS ACROSS ALL REPLICATES (*max # is 40 – 4 reps x10 pieces. No statistical analysis on these results)*	
		DEPTH	# OF COLONIES
MB + CP (75/25) 535 lb/ac (599 kg/ha), tarped	4	0.5 feet (0.2 meters) 2.0 feet (0.6 meters) 4.0 feet (1.2 meters)	0 10 40
Dual application Telone C-35 @ 65 gpa (608 L/ha) or approx. 650 lb/acre (728 kg/ha)	4	0.5 feet (0.2 meters) 2.0 feet (0.6 meters) 4.0 feet (1.2 meters)	0 0 20
1,3-D (330 lb/ac (370 kg/ha)) then metam sodium drench (110 lb/ac (123 kg/ha))	4	0.5 feet (0.2 meters) 2.0 feet (0.6 meters) 4.0 feet (1.2 meters)	5 20 38
1,3-D (330 lb/ac (370 kg/ha)) then Basamid drench (200 lb/ac (224 kg/ha))	4	0.5 feet (0.2 meters) 2.0 feet (0.6 meters) 4.0 feet (1.2 meters)	0 0 40
Non-treated check	4	0.5 feet (0.2 meters) 2.0 feet (0.6 meters) 4.0 feet (1.2 meters)	37 30 30

McKenry, 2000 (This study was conducted on tree nurseries).

CALIFORNIA NURSERY ROSES – TABLE 16.3: EFFECTIVENESS OF ALTERNATIVES – STUNT NEMATODE

KEY PEST: STUNT NEMATODE	Disease (% or rating) Mean of 6 replications			
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF REPS	0-12 INCHES (0 – 0.3 METERS)	24-36 INCHES (0.6-0.9 METERS)	48-60 INCHES (1.2 – 1.5 METERS)
Untreated	6	1.0 b*	29.8 a	5.8 ab
Methyl bromide – 350 lb/acre (392 kg/ha), tarped – noble plow	6	0.0 b	0.0 b	0.0 c
30% Iodomethane 70% Chloropicrin – 400 lb/acre (448 kg/ha), tarped – noble plow	6	0.0 b	0.0 b	0.4 bc
Telone C35 – 48 gal/acre (449 L/ha) – noble plow	6	0.0 b	0.9 b	6.2 ab
Telone C35 – 48 gal/acre (449 L/ha); untarped – telone rig	6	0.0 b	0.3 b	3.5 abc
Inline – 50 gal/acre (468 L/ha), drip	6	0.0 b	0.3 b	2.4 abc
Telone EC – 35 gal/acre (327 L/ha), drip	6	0.0 b	0.9 b	6.9 ab
Chloropicrin – 200 lb/acre (224 kg/ha), drip	6	0.0 b	3.0 b	13.3 a
Chloropicrin – 400 lb/acre (448 kg/ha), drip	6	0.0 b	1.4 b	4.8 abc
Chloropicrin – 200 + 200 lb/acre (224 + 224 kg/ha), drip	6	0.0 b	0.0 b	4.2 abc
30% Iodomethane 70% - 400 lb/acre (448 kg/ha), drip	6	0.0 b	0.0 b	0.0 c
50% Iodomethane 50% Chloropicrin – 300 lb/acre (336 kg/ha), drip	6	0.2 b	0.0 b	0.0c
Metam sodium – 75 gal/acre (701 L/ha) (42% a.i.), drip	6	0.2 b	0.0 b	10.0 a
Iota (a bacterial suspension from FUSION 360, Turlock, CA)	6	5.5 a	47.8 a	7.9 ab

Schneider et al, 2002b
* Statistical analysis conducted on log transformed (ln(n+1)) data. Data presented are the antilogs of the means.
Stunt Nematode Populations per 250cc soil sampled at planting in a commercial rose trial. Results at other depths (12-24 inches (0.3-0.6 meters) and 36-48 inches (0.9-1.2 meters) are also available in the study.

CALIFORNIA NURSERY ROSES – TABLE 16.4: EFFECTIVENESS OF ALTERNATIVES – ROOT KNOT NEMATODE

KEY PEST: ROOT KNOT NEMATODE	ROOT KNOT NEMTAODE POPULATIONS PER 100 CC SOIL SAMPLED AT PLANTING IN A COMMERCIAL ROSE TRIAL MARCH 2003		
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF REPS	DISEASE (% OR RATING) # OF NEMATODES (SOIL SAMPLED TO A DEPTH OF 24 INCHES (0.6 METERS))	
		MEAN	RANGE
Untreated	6	18.0 a	0-805
Methyl bromide – 350 lb/acre (392 kg/ha), tarped – noble plow	6	0 c	0-0
30% Iodomethane 70% Chloropicrin – 400 lb/acre (448 kg/ha), tarped – noble plow	6	0 c	0-0
Telone C35 – 48 gal/acre (449 L/ha) – noble plow	6	0.8 bc	0-32
Telone C35 – 48 gal/acre (449 L/ha); untarped – telone rig	6	6.4 ab	0-354
Inline – 50 gal/acre (468 L/ha), drip	6	0 c	0-0
Telone EC – 35 gal/acre (327 L/ha), drip	6	0 c	0-0
Chloropicrin – 200 lb/acre (224 kg/ha), drip	6	0 c	0-0
Chloropicrin – 400 lb/acre (448 kg/ha), drip	6	0 c	0-0
Chloropicrin – 200 + 200 lb/acre (224 + 224 kg/ha), drip	6	0 c	0-0
30% Iodomethane 70% - 400 lb/acre (448 kg/ha), drip	6	0 c	0-0
50% Iodomethane 50% Chloropicrin – 300 lb/acre (336 kg/ha), drip	6	0 c	0-0
Metam sodium – 75 gal/acre (701 L/ha) (42% a.i.), drip	6	0.5 bc	0-12
Iota (a bacterial suspension from FUSION 360, Turlock, CA)	6	10.8 a	0-213

Schneider et al, 2003b

Statistical analyses conducted on log transformed (log(n+1)) data. Data presented are antilogs of the means, as well as the range of values. Means followed by the same letter are not significantly different at the *P*=.05 level.

California Nursery Roses – Table C.1: Alternatives Yield Loss Data Summary

Although yield and quality losses may occur due to key pests, the only studies for nursery roses are ongoing. Because these studies are in progress and the crop is perennial, yield losses have not been determined. However, the crop must meet certification requirements or the stock will not be accepted. The pests must be controlled or the growers will not be able to sell their product.

Alternative	List Type of Pest	Range of Yield Loss	Best Estimate of Yield Loss
See paragraph above.	Nematodes	Not applicable	Not applicable
Overall Loss Estimate for All Alternatives to Pests			Not applicable; certification issues

California Nursery Roses - 17. Are There Any Other Potential Alternatives Under Development which Are Being Considered to Replace Methyl Bromide?

The industry is developing technologies to improve efficacy of alternatives such as deep injection methods, soil moisture management by improving drip technologies, experience with virtually impermeable films to increase efficacy and decrease emissions. Between 2001 and 2003, $60,000 was devoted to nursery rose alternatives research at USDA and on farm research.

Iodomethane will control the target pests but is not currently registered.

California Nursery Roses - 18. Are There Technologies Being Used to Produce the Crop which Avoid the Need for Methyl Bromide?:

1,3-D can be used in some situations, such as areas with sandy soils where the soil moisture can be reduced to 12 percent or less. According to California certification regulations, this alternative is not acceptable on soils known to be infested with nematodes (CDFA, 1996). Township caps also limit the use of this alternative. A grower that tried using 1,3-D found that weeds were not controlled satisfactorily.

Some growers are able to control their planting ground for long periods of time thus avoiding crops and weeds that are hosts to nematodes. However, re-infestation is always a threat through contaminated irrigation water, runoff water, or weeds. In addition, the income from the rotational crop, often a cereal crop, is about 1/3 of that received for roses.

CALIFORNIA NURSERY ROSES - SUMMARY OF TECHNICAL FEASIBILITY

Although 1,3-D with chloropicrin has been demonstrated as an effective alternative in some situations, in many cases it does not control the target pests. In soils with moisture levels above 12 percent, 1,3-D does not provide control of nematodes. In addition, 1,3-D does not control *Verticillium dahilae*, *Pythium* spp., or weeds. Also, there are regulatory limitations to the use of 1,3-D. Growers must meet certification requirements. Only under specific circumstances, such as an area with sandy soils (moisture levels below 12 percent) with no known nematode problems, may this alternative be used. In addition, township caps may limit the availability of this alternative to growers, especially since nursery roses are primarily produced in two townships, where other crops that use 1,3-D are also grown.

Other alternatives, such as metam sodium and dazomet do not provide consistent control of target pests to a depth of 1.5 meters.

Although iodomethane provides good control of the target pests, it is not currently registered.

PART D: EMISSION CONTROL

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?	Currently some growers use HDPE tarps. VIF might be a feasible means of reducing emissions if physical properties of VIF can be improved, especially the ability to successfully and consistently roll the film over beds without breakage and ability to glue the material.	Most nurseries have reduced MB amounts to lower rate formulations. Between 1997 and 2001, the U.S. has achieved a 36% reduction in use rates.	From 2% to 33% or 25% (for some nurseries)	No
WHAT FURTHER USE/EMISSION REDUCTION STEPS WILL BE TAKEN FOR THE METHYL BROMIDE USED FOR CRITICAL USES?	Research is underway to develop use in commercial production systems	Research is underway to develop use of a 50% MB formulation where pest pressure allows.	Research is underway to develop use of a 50% MB formulation where pest pressure allows.	Not likely
OTHER MEASURES *(please describe)*	Unidentified	Unidentified	Unidentified	Fumigation once every 2 – 3 years

20. IF METHYL BROMIDE EMISSION REDUCTION TECHNIQUES ARE NOT BEING USED, OR ARE NOT PLANNED FOR THE CIRCUMSTANCES OF THE NOMINATION, STATE REASONS

Reduction technology is being addressed by this sector. For example, VIF products, use of advanced delivery techniques, such as deep injection, to make alternative chemicals more effective at deeper soil levels, and reduction in use rate of MB to 50:50. While new mixtures and formulations can be effective at controlling target pests, especially at low pest pressure, the long term efficacy of these mixtures is unknown.

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

WESTERN RASPBERRY NURSERIES - TABLE E.1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA DECIDUOUS FRUIT & NUT TREE GROWERS - TABLE E.2: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA NURSERY ROSES - TABLE E.3: 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 because most of the losses cannot be quantified because there are no data to substantiate the magnitude of these losses.

Certification requirements. The requested amount of methyl bromide in the U. S. nomination includes only those areas where 1,3 dichloropropene (1,3-D) would not meet the certification requirements or would be limited by township caps. The requirement that the nursery stock be certified as pest free is what makes the alternatives economically infeasible. Under California regulatory laws, nursery crops must be "free of especially injurious pests and disease symptoms" in order to qualify for a California Department of Food and Agriculture (CDFA) Nursery Stock Certificate for Interstate and Intrastate Shipments (CDFA, 1996). If an approved fumigation is not used in the nursery, a costly nematode sampling procedure is imposed by CDFA, and if nematodes are found all nursery stock in an area should be destroyed resulting in a complete loss. Methyl bromide meets the certification guidelines. Also, in certain soil conditions, 1,3-D meets certification guidelines; however, California township caps imposed by the CDPR (California Department of Pesticide Regulation) may limit the use of 1,3-D.

If an approved fumigation is not used and a nematode sampling procedure is imposed by CDFA, it is likely that nematodes would be found because:

- 1,3 D is less effective in soil conditions where 1,3 D does not meet the certification guidelines, or
- There is no effective nematicide if 1,3 D cannot be used due to California township caps.

If nematodes are found and the nursery stock cannot be certified "free of especially injurious pests and disease symptoms", then a total loss is likely because the nursery stock:

- Would not qualify for a CDFA Nursery Stock Certificate for Interstate and Intrastate Shipments,
- Would probably not be marketable, since resale for planting is severely restricted by the CDFA.
- Should be destroyed to prevent further infestation.

Yield loss. It is likely that yield losses would also occur where soil conditions are not ideal, but little data are available. The yield loss could be 100% if the nursery stock cannot be certified as pest free.

Reduced pesticide use. An effective fumigation results in a growth response that allows an initial growth spurt. This growth response helps maintain a healthy plant, which is able to better handle the stress induced by pathogens and pests. A healthier plant consequently requires a fewer number of pesticide sprays during the season.

Beyond the nursery. Healthier plants and trees provide benefits beyond the nursery in terms of higher yields of fruit and nuts and reduced infestations. One hectare of nursery stock provides these benefits to many hectares producing fruits and nuts.

PART F. FUTURE PLANS

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

Primarily, development of technologies to improve efficacy of alternatives such as deep injection methods, soil moisture management by improving drip technologies, experience with virtually impermeable films to increase efficacy and decrease emissions, while allowing reasonable cost effectiveness. Even where MB is considered critical, an improvement in efficient delivery techniques will result in reduction of MB use requirements. For roses, future research is planned for nematodes, *Pythium* and weeds. For 2001-2003, $60,000 is devoted to alternatives research at USDA and on farm research. Raspberry nurseries have spent $100,000 on research, including $20,000 on screening resistance for *Phytophthora* and *Verticillium*, and over $60,000 over the last decade studying various alternatives in the large Watsonville, California area. Between 1999 and 2000, the California fruit, vine, and nut industries have spent $378,467 on numerous research projects. From 2002-2003, $262,002 were granted to researchers by this industry. In addition, an equal amount has been granted by government and universities.

The amount of methyl bromide requested for research purposes is considered critical for the development of effective alternatives. Without methyl bromide for use as a standard treatment, the research studies can never address the comparative performance of alternatives. This would be a serious impediment to the development of alternative strategies. The U.S. government estimates that orchard seedlings research will require 1506 kg per year of methyl bromide for 2005 and 2006. This amount of methyl bromide is necessary to conduct research on alternatives and is in addition to the amounts requested in the submitted CUE applications. One example of the research is a two year field study testing the comparative performance of methyl bromide, 1,3-D, iodomethane, sodium azide, resistant cultivars, and fallow for control of nematodes and weeds. Another example is a five year field study comparing methyl bromide to 1,3-D, chloropicrin, iodomethane, fallow, cover crops, solarization, and other treatments for control of nematodes and soil borne pathogens.

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

As stated in Section 23, minimizing use of MB can be achieved through the development of technologies to improve efficacy of alternatives such as deep injection methods, soil moisture management by improving drip technologies, experience with virtually impermeable films to increase efficacy and decrease emissions, and still have reasonable cost effectiveness. Even where MB is considered critical, an improvement in efficient delivery techniques will result in reduction of MB use requirements. As described in Section 23, considerable resources are being devoted to finding MB alternatives. Plans to develop VIF, deep injection, 1,3-D efficacy, and reduction of MB use rates are all ongoing. Transferring these technologies to field situations requires additional time. Until these alternatives can be relied, MB is critical for this sector. The U.S. wants to note that our usage rate is among the lowest in the world in requested sectors and represents efforts of both the government and the user community over many years to reduce use rates and emissions. We will continue to work with the user community in each sector to identify further opportunities to reduce methyl bromide use and emissions.

25. Additional Comments on the Nomination?

This methyl bromide critical use exemption nomination for raspberry, rose, and deciduous tree nurseries has been reviewed by the United States government and meets the guidelines of The *Montreal Protocol on Substances That Deplete the Ozone Layer*. This use is considered critical because there are no technically and economically feasible alternatives or substitutes available for nurseries that have heavy soils, are restricted by township caps of 1,3-D, and/or have state mandated certification standards that require the use of MB in situations where 1,3-D is not allowed or effective. The loss of MB under these circumstances would, therefore, result in a significant market disruption and provides the basis for nomination of this sector for critical use exemption of MB.

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

Methyl Bromide Critical Use Exemption Process	**Date:** 2/26/2004	**Average Hectares in the US:**	not available
2006 Methyl Bromide Usage Numerical Index (BUNI)	**Sector:** FRUIT, NUT, & FLOWER NURSERY	**% of Average Hectares Requested:**	not available

REGION	2006 Amount of Request			2001 & 2002 Average Use*			Quarantine and Pre-Shipment	Regional Hectares**		
	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)		2001 & 2002 Average	% of 2001 & 2002 Average	% of Requested Hectares
Western Raspberry Nursery Consortium	49,879	197	253	27,379	117	235	60%	not available	not available	not available
CA Rose Growers	209,975	622	337	201,667	615	328	90%	not available	not available	not available
CA Assoc. - Fruit & Nut Tree Growers	224,528	668	336	212,689	633	336	85%	not available	not available	not available
TOTAL OR AVERAGE	**484,382**	**1,487**	**309**	**441,735**	**1,364**	**300**	**78%**	not available	not available	not available

2006 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE			
REGION	2006 Request	(-) Double Counting	(-) Growth or 2002 CUE Comparison	(-) Use Rate Difference	(-) QPS	HIGH	LOW	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	% Reduction
Western Raspberry Nursery Consortium	49,879	-	20,363	2,137	16,427	10,952	10,952	10,952	47	235	78%
CA Rose Growers	209,975	-	2,526	5,782	181,500	20,167	20,167	20,167	61	328	90%
CA Assoc. - Fruit & Nut Tree Growers	224,528	-	11,839	-	180,786	31,903	31,903	31,903	95	336	86%
Nomination Amount	**484,382**	**484,382**	**449,655**	**441,735**	**63,022**	**63,022**	**63,022**	**63,225**	**203**	**311**	**87%**
% Reduction from Initial Request	**0%**	**0%**	**7%**	**9%**	**87%**	**87%**	**87%**	**87%**	**86%**		

Adjustments to Requested Amounts	Use Rate (kg/ha)		(%) Karst Topography		(%) 100 ft Buffer Zones		(%) Key Pest Distribution		Regulatory Issues (%)		Unsuitable Terrain (%)		Cold Soil Temp (%)		Combined Impacts (%)	
REGION	2006	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	HIGH	LOW
Western Raspberry Nursery Consortium	253	235	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%
CA Rose Growers	337	328	0	0	0	0	100	100	44	31	0	0	0	0	100%	100%
CA Assoc. - Fruit & Nut Tree Growers	336	336	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%

Other Considerations	Dichotomous Variables (Y/N)					Other Issues			Economic Analysis					
REGION	Strip Bed Treatment	Currently Use Alternatives?	Research / Transition Plans	Tarps / Deep Injection Used	Pest-free Cert. Requirement	Change from Prior CUE Request (+/-)	Verified Historic MeBr Use / State	Frequency of Treatment	Loss per Hectare (US$/ha)	Loss per Kilogram of MeBr (US$/kg)	Loss as a % of Gross Revenue	Loss as a % of Net Revenue	Quality/ Time/ Market Window/ Yield Loss (%)	Marginal Strategy
Western Raspberry Nursery Consortium	No	No	Yes	Tarp	Yes	+	Yes	2-3 yr					9% or 14% or 30%	1,3-D or 1,3-D+Pic or Metam+Pic
CA Rose Growers	No	Yes	Yes	Tarp	Yes	-	Yes	3-5 yr					not applicable	not applicable
CA Assoc. - Fruit & Nut Tree Growers	No	No	Yes	Tarp	Yes	0	Yes	3-5 yr					not applicable	not applicable

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

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

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

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

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

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

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

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

35. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked

36. **Change from Prior CUE Request**- This variable takes a '+' if the current request is larger than the previous request, a '0' if the current request is equal to the previous request, and a '-' if the current request is smaller that the previous request.
37. **Verified Historic Use/ State**- This item indicates whether the amounts requested by administrative area have been compared to records of historic use in that area.
38. **Frequency of Treatment** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.

39. **Economic Analysis** – provides summary economic information for the applications.

40. **Loss per Hectare** – This measures the total loss per hectare when a specific alternative is used in place of methyl bromide. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
41. **Loss per Kilogram of Methyl Bromide** – This measures the total loss per kilogram of methyl bromide when it is replaced with an alternative. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
42. **Loss as a % of Gross revenue** – This measures the loss as a proportion of gross (total) revenue. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
43. **Loss as a % of Net Operating Revenue** -This measures loss as a proportion of total revenue minus operating costs. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars. This item is also called net cash returns.

44. **Quality/ Time/ Market Window/Yield Loss (%)** – When this measure is available it measures the sum of losses including quality losses, non-productive time, missed market windows and other yield losses when using the marginal strategy.
45. **Marginal Strategy** -This is the strategy that a particular methyl bromide user would use if not permitted to use methyl bromide.

APPENDIX B. SUMMARY OF NEW APPLICANTS

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

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

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

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

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

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

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