Methyl Bromide Critical Use Nomination for Preplant Soil Use for Ornamentals Grown in Open Fields or in Protected Environments

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 Ornamentals Grown in Open Fields or in Protected Environments

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

2. DESCRIPTIVE TITLE OF NOMINATION:

Methyl Bromide Critical Use Nomination for Preplant Soil Use for Cut Flower and Bulb Ornamentals Grown in Open Fields or in Protected Environments

3. CROP AND SUMMARY OF CROP SYSTEM:

In the United States cut flowers, cut foliage and bulb crops are grown in open fields and under cover (including glass, poly, and saran). In 1997, eight percent of the ornamentals in the United States were grown under cover and 92 percent were grown in the open. There are three basic systems in place for ornamentals. Annuals are shallow rooted crops that represent 50 to 60 percent of the industry. They are often planted to a depth of 6 to 8 inches. Fumigants can be shanked into the preformed beds or drip-applied from drip tapes placed on tops of beds under plastic mulch. Bulb crops represent about 30 percent of the industry. Fumigants are applied on the flat by deep shanking. Bedding up generally occurs after planting the bulbs. Perennials are deep-rooted multi-year crops and represent 10 to 20 percent of the industry in California. Fumigation needs to penetrate to a depth of 2 to 3 feet and may require multi-level shanking.

Methyl bromide is used in almost all saran house production – snap dragons, asters, gerbera daisies, mums, etc, as a broadcast solid tarp treatment. It is used in field grown statice and gypsophila as an in-bed treatment. In some gladiolus production, methyl bromide is used broadcast solid tarp for increase of cormels and tissue culture stock (Ragsdale, 2004).

This nomination is for multiple species (see Appendix A) but two species will be used as examples when possible: caladiums and ranunculus.

Caladiums are grown in Florida on either sandy or muck soils. They are planted from the middle of March until mid April. Caladiums are dug annually from November until the middle of March. The rhizomes are cleaned, graded, repacked, and stored until shipment to customers throughout the world. Methyl bromide is applied in the short time period between the end of harvest of one crop and the planting of the next.

Ranunculus are grown as annuals in the field. In fall, seeds are planted on beds. Flowers are harvested in the spring and the tubers are harvested in July and August. These tubers are used in landscaping and planted in the fall (Elmore et al., 2003b).

Without methyl bromide, growers will suffer both yield and quality losses. There is a need to control previous planted varieties to eliminate contamination, as well as control other weeds and pathogens. Some of the alternatives that have been found for other crops are not be feasible for some floriculture crops because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, and buffer zone requirements. In California, township caps limit the use of 1,3-D as an alternative. Although some alternatives have shown potential to replace methyl bromide use in some situations, the in-field feasibility of the alternatives for each of the major species of ornamentals grown in the United States remains to be demonstrated. The industry has made progress in reducing the use of methyl bromide and additional research in ongoing. Additional time is needed to complete the phase-out of methyl bromide in this sector due to the complexity of production (numerous species, each with its own pests and implementation issues).

4. METHYL BROMIDE NOMINATED:

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)	NOMINATION AREA (HA)
2006	**230,856**	**578**

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

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

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in ornamental production.
- Key target pests: the U.S. is only nominating a CUE where the key pest pressure is moderate to high.
- Regulatory constraints: e.g., in some areas of the United States 1,3-Dichloropropene use is limited due to township caps in California.
- Delay in planting and harvesting: e.g., the plant-back interval for telone+chloropicrin is two weeks longer than methyl bromide+chloropicrin, and in the northern parts of the United States an additional delay would occur because soil temperature must be higher to fumigate with alternatives. Delays in planting and harvesting result in users missing key market windows, and adversely affect revenues through lower prices.

Overall, the ornamentals industry has hundreds of crop species and thousands of varieties. This diversity makes finding methyl bromide alternatives for each crop species complex, time consuming and costly (Schneider, 2003).

As part of the overall ornamentals industry, the cut flower, foliage, and bulb industry is very complex. For example, a single grower in California may grow as many as 100 species and/or varieties in a single year. Growers must find methyl bromide alternatives that will control previous crops grown on the site, as well as a diversity of key pests, which vary for each crop variety. For example, in ranunculus, residual tubers, bulbs, and seeds from the previous crop must be killed because they are reservoirs for nematodes and soil pathogens and considered to be weeds themselves as they are off-variety. Along with these issues, there are concerns about phytotoxicity and registration with alternative chemicals (Schneider, 2003; Elmore et al., 2003b). Recent experiences with iodomethane indicate that new chemistries can take several years to be registered by the U.S. EPA and the state regulatory agencies, such as California Department of Pesticide Regulation. In addition, township caps in California restrict the amount of 1,3-

Dichloropropene that can be used in a given area (Trout, 2001). Buffer zones may also limit the adoption of alternatives.

TABLE A.1: EXECUTIVE SUMMARY*

Region		*Ornamentals*
AMOUNT OF NOMINATION		
2006	**Kilograms**	230,856
	Application Rate (kg/ha)	392
	Area (ha)	578
AMOUNT OF APPLICANT REQUEST		
2005	**Kilograms**	226,796
	Application Rate (kg/ha)	392
	Area (ha)	578
2006	**Kilograms**	226,796
	Application Rate (kg/ha)	392
	Area (ha)	578
ECONOMICS		
Marginal Strategy		**Metam Sodium**
Yield Loss (%)		20 %
Loss per hectare (U.S.$/ha)		4,980
Loss per kg Methyl Bromide (U.S.$/kg)		11.11
Loss as % of Gross Revenue (%)		19%
Loss as % of Net Revenue (%)		43%

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

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

In California, township caps for 1, 3-Dichloropropene limit the number of growers that are able to use 1,3-D + chloropicrin. Further, because the ornamentals industry is complex, time is needed to determine methyl bromide alternatives for all species and varieties grown, including determining whether there are any phytotoxicity issues from using methyl bromide alternatives (Schneider, 2003). Some of the alternatives that have been found for other crops are not feasible for floriculture because of their high cost, difficulties with quickly treating and replanting fields for multi-cropping, and/or buffer zone requirements (Elmore, 2003a). Ornamentals have a high value; as a result many manufacturers now avoid registering materials for ornamental crops because of liability due to potential phytotoxicity issues.

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 (HA)	PROPORTION OF TOTAL CROP AREA TREATED WITH METHYL BROMIDE (%)
Ornamentals – California*	10,054	6.3%
Caladiums – Florida**	648	85%
REGIONAL TOTAL:	10,702	11%
NATIONAL TOTAL:	Not Available	Not Available

* 2000 California Department of Pesticide Regulation Data
** Based on information from experts in Florida

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.

Given the number and diversity of species grown in the industry, there are a number of reasons why methyl bromide is not used. Some crops have been able to switch to alternatives. For example, growers in Oregon are now using 1,3-Dichloropropene for Easter lilies. Also, some species may not need methyl bromide, depending on their key pests and the ability to use alternatives.

Growers are also maximizing their use of methyl bromide. Instead of fumigating after each crop (more than once a year), producers may grow several crops over 1 to 2 years on the same piece of land, using methyl bromide only when necessary instead of after every crop, and thus reducing the amount used. Cropping systems have been changed to allow most sensitive crops to be planted immediately following a fumigation followed by several other types of plants in decreasing sensitivity to soil pathogens. Costs of fumigation alone made this a critical change in cut flower production. In addition, some perennials may be grown for 5 to 25 years. Methyl bromide would only be used once during this cycle.

In this industry, the fumigation situation and need for methyl bromide varies by species. Although there are some potential alternatives, there is not enough grower experience for all crop species to switch to alternatives at this time. One major difficulty is that market desires require a high degree of flexibility in scheduling certain species and new cultivars. Therefore, the information on the sensitivity of each crop to fumigant alternatives as well as the pests is not known until crops have been in production for at least a few cycles.

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?

Not all of the above methods and alternatives being used are feasible for other crops. However, the industry is working to find alternatives to methyl bromide.

Specifically, township caps in California limit the use of 1,3-Dichloropropene. Many of the crops are grown in coastal areas, where cut flowers are also grown. It is expected that about 30 percent of the 2000 fumigated cut flower acres could not have used 1,3-D at the current 2X cap, which is expected to apply through at least 2006. This number would be higher with the standard (1X) caps. Affecting some rotations are plant back times, which can be 1 to 2 weeks longer with 1,3-D. Combined regulatory and plant back limitations could restrict use of 1,3-D in California to less than 50 percent of the current fumigated area (Trout, 2003; Ragsdale, 2004). In addition, an alternative that works for one crop species may not control the key pests of another species or it could be phytotoxic to the other species. The industry needs additional time to complete ongoing research to find and implement alternatives for each species. The industry needs plans to complete the transition by the end of 2006.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

ORNAMENTALS - TABLE 8.1: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION:	**Ornamentals**	
YEAR OF EXEMPTION REQUEST	**2005**	**2006**
KILOGRAMS OF METHYL BROMIDE	226,796	226,796
USE: FLAT FUMIGATION OR STRIP/BED TREATMENT	Flat Fumigation	Flat Fumigation
FORMULATION *(ratio of methyl bromide/Chloropicrin mixture)* TO BE USED FOR THE CUE	67:33	67:33
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	578	578
APPLICATION RATE* *(kg/ha)* FOR THE **FORMULATION**	585	585
APPLICATION RATE* *(kg/ha)* FOR THE **ACTIVE INGREDIENT**	392	392
DOSAGE RATE* *(kg/ha)* OF **FORMULATION** USED TO CALCULATE REQUESTED KG OF METHYL BROMIDE	585	585
DOSAGE RATE* *(kg/ha)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KG OF METHYL BROMIDE	392	392

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

TABLE A.2: 2005 SECTOR REQUEST-- ORNAMENTAL*

2005 Ornamental Sector Request		
Applicant Request	Requested Hectares (ha)	578
	Requested Application Rate (kg/ha)	392
	Requested Kilograms (kg)	226,796

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

TABLE A.3: 2006 SECTOR NOMINATION-- ORNAMENTALS*

2006 Ornamentals Sector Nomination		
Applicant Request	Requested Hectares (ha)	578
	Requested Application Rate (kg/ha)	392
	Requested Kilograms (kg)	226,796
CUE Nominated	Nominated Hectares (ha)	578
	Nominated Application Rate (kg/ha)	392
	Nominated Kilograms (kg)	226,796

Sector Nomination Totals	Overall Reduction (%)	0%
	2006 U.S. CUE Nomination (kg)	**226,796**
	Research Amount (kg)	**4060**
	Total U.S. Sector Nominated Kilograms (kg)	**230,856**

ORNAMENTALS - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

ORNAMENTALS - 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

ORNAMENTALS - 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 NEEDED *(e.g. Effective herbicide available, but not registered for this crop; mandatory requirement to meet certification for disease tolerance)*

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

Ornamentals	All soil borne diseases, weeds, and nematodes. Includes *Fusarium* spp., *Rhizoctonia* spp., *Phytoplithora*, Stromatinia, *Pythium* spp., and most soil nematodes i.e. *Meliodogyne* spp., and previous crop propagules. Specific pest problems vary by individual crop and variety. See Appendix C for more detailed information.	Due to the diversity and complexity of the cut flower and foliage industry, an additional 4.5 years are needed to complete ongoing research into implementation of methyl bromide alternatives and to allow time for registering materials. Alternatives have not been found for all species. Some of the alternatives that have been found for other crops may not be feasible for floriculture because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, township caps, and buffer zone requirements (Elmore et al., 2003a).

ORNAMENTALS - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE *(Place major attention on the key characteristics that affect the uptake of alternatives):*

ORNAMENTALS - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	ORNAMENTALS
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Cuttings, bulbs
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual and perennial
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	A California cut flower producer may grow more than 20 ornamental species and hundreds of individual varieties. Crops are grown in rotation on an 8 to 16 week interval per year on the same parcel of land. Although species are rotated, the complex nature of this crop makes a *typical* crop rotation difficult to identify. Instead, examples of two different types of rotation will be described here. In Florida, caladiums are planted between the middle of March and the middle of April each year. Caladiums are dug annually from November until the middle of March. The fields are fumigated between harvest and the next planting. A more complex crop rotation system for a grower may involve several annuals. The first annual crop is planted and harvested 90 to 180 days later. A different species is planted immediately after the first harvest. Harvest follows approximately 90 to 180 days later. A third crop is then planted. Fumigation would occur when the production starts to decline, which may be an interval of one to two years. Most growers produce numerous species, including annuals, perennials, and bulbs, throughout the farm. The rotation involving all of these species would be more complex than the examples above.
SOIL TYPES: *(Sand, loam, clay, etc.)*	All. For example, caladiums are grown in central Florida, mostly on muck but with new acreage on sand. Cut flowers in California are primarily produced in the coastal environment where nearly all types of soil are present.
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	In general, once every year although it may occur less often on a substantial portion of the acreage in this sector that produce perennials and gladiolus.
OTHER RELEVANT FACTORS:	None identified.

Tables 11.2 and 11.3 are examples of the characteristics of climate and crop schedule for two species – caladium and ranunculus. These characteristics may vary for other species and other growing regions.

ORNAMENTALS - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – CALADIUM (FLORIDA)

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	9a – 11 Plant hardiness zone											
RAINFALL *(mm)**	65.5	50.0	72.6	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8
OUTSIDE TEMP. *(°C)**	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
FUMIGATION SCHEDULE	X											
PLANTING SCHEDULE		X										
HARVESTING SCHEDULE									X	X	X	X

* Date based on Tampa, Florida records for 1971–2000.

ORNAMENTALS - TABLE 11.3 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – RANUNCULUS (CALIFORNIA)

The ranunculus crop is different from other cut flower, foliage, and bulb crops because they have two planting sequences to ensure long season availability of the product. The first sequence occurs on a very small percent of the acreage and used only to produce cut flowers. It begins with land preparation in May followed by fumigation in June. Planting occurs in June and July and flowers are harvested from September through February. The main planting is used to produce both cut flowers and bulbs. Land preparation occurs in August followed by fumigation in September and October. Planting occurs from September through December with harvesting of cut flowers occurring from February through May (possibly into June in some years).

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	9a – 11 Plant hardiness zone.											
RAINFALL *(mm)**	16.0	72.1	17.3	0	Trace	1.0	Trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(°C)**	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE				X		Land prep	X	X				
PLANTING SCHEDULE					X (very small area)			X	X	X		
KEY MARKET WINDOW	X	X	X	X			X	X	X	X	X	X

*Data for Jan-Aug, 2003 and Sep-Dec 2002 for Fresno, California.

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

Caladium

Caladiums are dug annually from November through March 15. The time frame between lifting the previous year's crop and planting the new crop is about 30 days, or possibly shorter when severe cold temperatures or unexpected rainfall occurs. Any product with a fallow (post-treatment) time of 30 days or more will not work for this industry as fields must be planted before April 15 each year and cannot be prepared for planting until the middle of March.

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

ORNAMENTALS - 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)*	833 (CA)	700 (CA)	610 (CA)	617 (CA)	373 (CA)	529 (CA)
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	281,905 (CA)	238,824 (CA)	185,475 (CA)	173,230 (CA)	98,896 (CA)	117,395 (CA)
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	67:33; 98:2	67:33; 98:2	67:33; 98:2	67:33; 98:2	67:33; 98:2	67:33; 98:2
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked
APPLICATION RATE OF FORMULATIONS IN kg/ha*	487 (FL)	487 (FL)	487 (FL)	392 – 448 (FL)	392 – 448 (FL)	392 - 448 (FL)
APPLICATION RATE OF ACTIVE INGREDIENT IN kg/ha*	338 (CA)	340 (CA)	304 (CA)	281 (CA)	264 (CA)	222 (CA)
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	487 (FL)	487 (FL)	487 (FL)	392 - 448 (FL)	392 – 448 (FL)	392 -448 (FL)
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	338 (CA)	340 (CA)	304 (CA)	281 (CA)	264 (CA)	222 (CA)

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

The California (CA) application rate includes both outdoor and greenhouse use. The outdoor use rate is lower than the greenhouse rate. For example, in 2002 the outdoor use rate was 178 kg/ha and the greenhouse rate was 318 kg/ha. In Florida (FL), the higher rates tend to be used on muck soils and the lower rates on sandy soils.

Growers are expected to use a 67:33 formulation in the future, although this may vary depending on the crop grown and the pest situation. It is not clear that a 50:50 formulation is feasible. In Florida, caladiums are grown on muck and sandy soils. The majority are grown on muck soils, which require a higher application rate because it is more difficult for the fumigant to be distributed evenly in this soil type.

ORNAMENTALS - PART C: TECHNICAL VALIDATION

ORNAMENTALS - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

ORNAMENTALS – 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	Township caps are in place for 1,3-D that limit its use in California. Many of the crops are grown in coastal areas, where cut flowers are also grown. It is expected that about 30 percent of the 2000 fumigated cut flower acres could not have used 1,3-D at the current 2X cap, which is expected to apply through at least 2006. This number would be higher with the standard (1X) caps. Affecting some rotations are plant back times, which can be 1 to 2 weeks longer with 1,3-D. Combined regulatory and plant back limitations could restrict use of 1,3-D in California to less than 50 percent of the current fumigated area (Trout, 2003; Ragsdale, 2004). In California, buffer zones of 100 to 300 feet make using this alternative difficult because often flowers are produced on small parcels of land. 1,3-D cannot be used in greenhouses. For caladiums, chloropicrin was needed in addition to 1,3-D to reach the same yield as methyl bromide plus chloropicrin (Overman and Harbaugh, 1983). The plant-back window for caladiums is variable and the 1,3-D plant-back interval will limit use on some acres. In addition, caladium growers are reluctant to use 1,3-D because it does not control weeds. Growers also have to tarp 1,3-D and do not have the equipment to do it themselves (they can apply metam sodium themselves) (Gilreath, 2004).	No.

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Metam sodium	In California, buffer zones of 500 feet make using this alternative difficult because flowers are produced on small parcels of land. Also, this alternative is not labeled for greenhouse use in California. In addition, the plant back restrictions may cause some growers to be able to grow fewer crops in a year. Many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Metam sodium is used by some growers of caladiums in rotation with methyl bromide, due to the expense of methyl bromide. Growers feel that they can use metam sodium if they used methyl bromide the previous year. The growers that have tried using metam sodium 2 years in a row had bad nematode infestations the second year and will now only use it once every 2 years. Most growers will not use metam sodium because they must meet certification requirements (free of nematodes) for certain markets (several U.S. states and some international markets) (Gilreath, 2004). This fumigant is currently used and will continue to be used where it gives adequate pest control. It is unlikely that metam sodium will replace significant portions of the current use of methyl bromide.	No.
Dazomet (Basamid)	In some cut flowers (carnation and chrysanthemum) dazomet was effective against *Fusarium*, *Rhizoctonia*, *Erwinia*, and *Pseudomonas.* Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year.	No.
Chloropicrin	Chloropicrin may not currently be used in greenhouses in California. In California, buffer zones vary with county and condition in California. Buffer zones of 100 feet in sensitive areas make using this alternative difficult because flowers are produced on small parcels of land. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. Several California counties impose large buffers (>152 meters) and restrict rates to less than 224 kg/ha. Weed control is also poorer than with methyl bromide (Ragsdale, 2004).	No.
MITC	Same issues described above for metam sodium and dazomet.	No.
Non Chemical Alternatives		

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Biofumigation	Biofumigation is still largely in the experimental stages. (Pizano, 2001). Specific brassicas as well as specific years yield variable amounts of activity. While this alternative may provide some control, the control of all target pests is not sufficient. Also, brassica waste must be available in huge quantities to provide at best minor effects. The extremely large volume of raw material required makes this impractical.	No.
Solarization	Solarization takes several weeks to control many pests to a depth of 30 cm. This length of time for a treatment is not economically feasible in the intensive, year-round production situation of the cut flower industry (Pizano, 2001). Production areas in California are mainly coastal where solarization is not feasible due to cool temperatures and solar radiation most of the year.	No.
Steam	Steam can be a technically effective alternative in some cases. Reasons cited for not using steam for this crop system are high initial cost and an adverse affect on soil organic matter in enclosed structures. Some greenhouse growers have adapted this approach already in crops where it works better (such as Freesia). In-field steaming is not a feasible alternative due to lack of machinery that can deliver the steam, differences in soil type, and environmental impact of fuel use.	No.
Biological control	Results with biological control agents may vary with field or environmental conditions (Pizano, 2001). Even in small containers, biological control is not reliable for soil-borne pathogens.	No.
Crop residue compost/Crop rotation/fallow	Rotation is used extensively in cut flower production. However, in annual cropping they are generally too short for the full effects of rotating schemes to be effective. The previous crop (bulbs, corms) often contaminate the following crop or may harbor pathogens. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001). Flower rotations are generally not a true rotation in the pest control sense.	No.
Flooding and water management	Beds are generally designed and graded for good drainage to prevent standing water. Flooding could increase the incidence of certain diseases and is also time restrictive. (Environmental laws prohibit run-off in the most of the state of California making use (and often access) to water in this manner impossible).	No.
General IPM	Although IPM is currently practiced, this alone will not control weed and disease pests.	No.
Grafting/resistant rootstock/plant breeding	Grafting/resistant rootstock/plant breeding are not feasible alternatives. Given the thousands of varieties of ornamentals, plant breeding for the variety of pests is not practical.	No.
Organic amendments/compost	Not effective alone in weed or pest management; may be incorporated as part of an IPM program. Does not provide adequate weed and disease control.	No.

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Physical removal/sanitation	Appropriate sanitation practices are already used extensively.	No.
Resistant cultivars	Given the thousands of varieties of ornamentals, developing resistant cultivars for each variety, each with unique pest problems, is not practical. Choices are often market driven.	No.
Soilless culture / Substrates /plug plants	Container production may be possible in higher value cut flower crops but it not generally feasible, especially for deeper rooted crops and on large acreage.	No.
COMBINATIONS OF ALTERNATIVES		
1,3-Dichloropropene + chloropicrin	In California, 1,3-D use is limited by township caps, buffer zones, and plant back times, which could affect some rotations. 1,3-D cannot be used in greenhouses. For caladiums, chloropicrin was needed in addition to 1,3-D to reach the same yield as methyl bromide plus chloropicrin (Overman and Harbaugh, 1983). 1,3-D is also limited by the plant-back interval, the lack of weed control, and the lack of equipment necessary to fumigate with 1,3-D (Gilreath, 2004). In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.
1,3-Dichloropropene + chloropicrin + pebulate	Pebulate is currently not registered. In California, 1,3-D use is limited by township caps, buffer zones, and plant back times, which could affect some rotations. 1,3-D cannot be used in greenhouses. For caladiums, chloropicrin was needed in addition to 1,3-D to reach the same yield as methyl bromide plus chloropicrin (Overman and Harbaugh, 1983). 1,3-D is also limited by the plant-back interval, the lack of weed control, and the lack of equipment necessary to fumigate with 1,3-D (Gilreath, 2004). In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Dazomet (Basamid) + chloropicrin	In some cut flowers (carnation and chrysanthemum) dazomet was effective against *Fusarium*, *Rhizoctonia*, *Erwinia*, and *Pseudomonas.* Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year. In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.
Metam sodium + chloropicrin	In California, limitations to metam sodium include buffer zones, greenhouse uses are not labeled, and plant back restrictions. In addition, many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Metam sodium is used by some growers of caladiums in rotation with methyl bromide. The growers that have tried using metam sodium 2 years in a row had bad nematode infestations the second year and will now only use it once every 2 years. Most growers will not use metam sodium because they must meet certification requirements (free of nematodes) for certain markets (several U.S. states and some international markets) (Gilreath, 2004). This fumigant is currently used and will continue to be used where it gives adequate pest control. It will be unlikely to replace significant portions of current use of methyl bromide. In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Metam sodium + crop rotation	In California, limitations to metam sodium include buffer zones, greenhouse uses are not labeled, and plant back restrictions. In addition, many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Metam sodium is used by some growers of caladiums in rotation with methyl bromide. The growers that have tried using metam sodium 2 years in a row had bad nematode infestations the second year and will now only use it once every 2 years. Most growers will not use metam sodium because they must meet certification requirements (free of nematodes) for certain markets (several U.S. states and some international markets) (Gilreath, 2004). This fumigant is currently used and will continue to be used where it gives adequate pest control. It will be unlikely to replace significant portions of current use of methyl bromide. In annual cropping they are generally too short for the full effects of rotating schemes to be effective. The previous crop (bulbs, corms) often contaminate the following crop or may harbor pathogens. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001).	No.

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

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

ORNAMENTALS – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
Herbicides and fumigation with methyl bromide, 1,3-D and chloropicrin, metam sodium and chloropicrin	Caladium - All were effective for weeds but positive results may have been influenced by previous years of MB fumigation (Gilreath, et al, 1999). However, there was control on *Fusarium* and only MB reduced *Pythium*. Herbicides are more feasible for perennials if they are registered. The short time interval between crops (a crop may only take 90 days) often restricts the use of herbicides due to replant intervals or phytotoxicity. Also, herbicides are often selective and there are a limited number registered.
Hot water dips	Caladium rhizomes are cleaned with hot water dips (121-122F for 30 minutes). A fungicide/bactericide dip may follow. Some growers may spray the rhizomes with a fungicide to protect them from diseases. The hot water dip is effective at reducing root knot nematode on the rhizomes but fumigation is needed to maintain the control. Controlling *Fusarium* on the rhizomes will not control losses if the soil is contaminated by the previous year's pests.

Sodium azide	Preliminary results in a calla trial suggest that sodium azide may not be a feasible alternative in this crop due to reduced crop vigor and increased mortality (Gerik, 2003).

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

ORNAMENTALS – 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

ORNAMENTALS - 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

Preplant Pest Management in Ranunculus Production (Elmore et al., 2003b): Results from this study do not compare most of the alternatives to methyl bromide because most of the alternatives were used in higher moisture fields and methyl bromide was used in lower moisture fields. In lower moisture areas, the plots were treated with methyl bromide/chloropicrin or iodomethane/chloropicrin. In the higher moisture areas, the plots were treated dazomet or metam sodium. In addition, these treatments were followed with either Telone C-35 or 1,3-D plus chloropicrin. Controls were used in both the low and high moisture areas. Other treatments included drip applied metam sodium, iodomethane/chloropicrin, chloropicrin, sodium azide, or 1-3-D +chloropicrin, but yield results are not available. In all studies there were no statistical differences between treatments in either weed pressure or yield among the alternatives. In the lower moisture treatments, there was a 34 percent yield loss between methyl bromide and the untreated control. See Table 16.1 below for more detail. The lack of differences in the treatments is likely due to the lack of pest pressure in the higher moisture fields. The higher moisture fields needed for certain alternatives were only available in areas not previously planted to ranunculus, and therefore there was not a buildup of pest pressure over time (Mellano, 2003).

Evaluation of Alternatives to Methyl Bromide for Floriculture Crops (Gerik, 2003): In Trial 1, the following chemical treatments were evaluated: untreated control; sodium azide (112 kg ai/ha); furfural 50% + metam sodium 50% (672 kg ai/ha); 1,3-dichloropropene (272 kg/ha); 1,3-dichloropropene 65% + chloropicrin 35% (627 kg/ha); iodomethane 50% + chloropicrin 50% (336 kg/ha); iodomethane 33% + chloropicrin 66% (448 kg/ha); chloropicrin (448 kg/ha). Drip applications were used in all treatments. Sachets with malva and mustard seed, and nutsedge and calla rhizomes were buried in the plots before treatment to evaluate weed control efficacy. None of the treatments killed the malva seeds. Chloropicrin controlled the nutsedge and calla rhizomes. Mustard seed, *Pythium* spp. and *Fusarium oxysporum* were controlled or reduced by all treatments compared to the untreated control, in addition to overall weed emergence. Sodium azide was the only chemical treatment that did not reduce *Phytophthora* spp. populations and resulted in reduced crop vigor and mortality in the planted calla. At the time of the report, there were plans to collect additional data in the fall.

In Trial 3, the following treatments were evaluated: 1) untreated control; 2) Multiguard Protect/Metham 50/50 672 kg/ha; 3) Sodium Azide 112 kg/ha; 4) Multiguard FFA; 5) Vapam 935 L/ha; 6) Chloropicrin 336 kg/ha; 7) Inline 468 L/ha; 8) Iodomethane/Chloropicrin 30/70 448 kg/ha (Midas). The crop in this trial was Liatris. With the exception of iodomethane/chloropicrin and the control, the alternatives controlled Pythium. The alternatives, except iodomethane/chloropicrin, chloropicrin, and the control, controlled Fusarium. Weed control was comparable among the alternatives in most cases, with Multiguard FFA and the control providing the least level of control. Although iodomethane/chloropicrin did not control pathogens, it is suspected that it may be due to an application malfunction. At harvest, there was no significant difference in yield (stems/m^2)

Several trials were in progress at the time of the report and not all of the trials are discussed here.

ORNAMENTALS – RANUNCULUS - TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – WEEDS

KEY PEST: WEEDS	AVERAGE DISEASE % OR RATING AND YIELDS IN PAST 3~5 YEARS				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	# OF REPS	WEED CONTROL (WEED COUNTS PER 5 SQUARE FEET)		# OF REPS	ACTUAL YIELDS (TOTAL BUNCHES)
Lower moisture areas		**Malva**	**Clover**		
Methyl bromide/chloropicrin (50:50) 358 kg/ha	4	0.8 b	55.5	4	431.8 a
Iodomethane/chlorpicrin (50:50) 336 kg/ha	4	0.5 b	61.1	4	457.6 a
Iodomethane/chloropicrin (50:50) 392 kg/ha	4	0.5 b	43.6	4	426.5 a
Untreated – tarped	4	2.1 a	62.5	4	287.0 b
Higher moisture areas					
Metam sodium + Telone C-35 358 kg/ha + 327 L/ha	4	2.0 b	6.2	4	353.2
Metam sodium + 1,3-D + chloropicrin 358 kg/ha + 140 L/ha + 224 kg/ha	4	2.1 b	4.5	4	357.0
Metam sodium 358 kg/ha	4	3.1 b	3.2	4	357.3
Dazomet + Telone C-35 224 kg/ha + 327 L/ha	4	2.8 b	6.1	4	358.3
Dazomet + 1,3-D + chloropicrin 224 kg/ha + 140 L/ha + 224 kg/ha	4	2.1 b	5.5	4	332.5
Untreated – tarped	4	7.8 a	6.8	4	348.3

Elmore et al., 3003b

ORNAMENTALS – RANUNCULUS – TABLE 16.2: EFFECTIVENESS OF ALTERNATIVES – WEEDS

KEY PEST: WEEDS IN RANUNCULUS	WEED CONTROL AND RANUNCULUS VIGOR AFTER PREPLANT DRIP APPLICATION OF PESTICIDES IN SANDY SOIL				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	# OF REPS	DISEASE (% OR RATING)		# OF REPS	PLANT VIGOR*
		CLOVER (#/LINEAR M)	TOTAL WEEDS (#/ LINEAR M		
Metam sodium 364 kg/ha	6	13.5 a	13.7 a	6	9.2 ab
Iodomethane/chloropicrin 392 kg/ha	6	15.3 a	15.3 a	6	8.7 b
Chloropicrin 168 kg/ha	6	9.7 a	10.3 a	6	9.7 ab
Chloropicrin 336 kg/ha	6	12.8 a	13.3 a	6	9.7 ab
Sodium azide 112 kg/ha	6	12.2 a	12.2 a	6	8.7 b
1,3-D/chloropicrin 168 kg/ha	6	11.5 a	11.5 a	6	10.0 a
1,3-D/chloropicrin 336 kg/ha	6	8.3 a	8.3 a	6	9.5 ab
Untreated-tarped	6	15.3 a	16.8 a	6	6.0 c

(Elmore et al., 2003a)

* Visual evaluation: 10 = vigorous, 0 = dead

ORNAMENTALS – TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

Yield losses will vary by species but, based on expert opinion for the two representative crops, ranunculus and caladiums, an estimate has been determined. The experts are a cut flower producer and a researcher located in different areas of the country. Based on grower experience, it is estimated that 10 to 35 percent yield losses could occur without methyl bromide. These yield losses may be higher in highly diseased fields. Quality is also a major concern for the industry. In addition, ranunculus exported to Japan, Canada, and Europe need a certificate stating that it has been grown in manner not conducive to certain diseases, which generally means in a field fumigated with methyl bromide. Even in crops without these regulations, consumers expect a high quality product. Selling a product that is not of high quality will cause growers to lose customers. There are some promising alternatives for many crops, but more time is needed to determine what particular alternatives will work with individual crops to meet customer standards and avoid yield losses if methyl bromide can no longer be used (Mellano, 2003). In ranunculus, a 50 percent yield loss (flowers and tubers) can occur due to soil pathogens (Elmore et al., 2003b). The situation is similar for caladiums. Studies conducted on caladiums did not necessarily show yield or quality losses but any losses would depend on pest populations. Herbicides were also used to control weeds that wouldn't be controlled by the fumigant alone. In the first year, growers may experience a 5% reduction in the number of tubers in the most desirable size grades, with a 30% reduction in production in the second year possible. Losses are not likely to exceed 35 to 40%. Growers will likely find successful alternatives but more time is needed to transition to these alternatives (Gilreath, 2004).

Currently, the applicants do not consider any alternative to be a feasible replacement for methyl bromide in this diverse sector. However, in an attempt to provide an estimate the potential impacts from the adoption of the most common methyl bromide alternatives, the following table presents likely yield losses.

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D plus chloropicrin	Nematodes and Diseases (no control of weeds or previous crop)	10 to 25 %	25%
Dazomet	Multiple		25%
Metam Sodium	Multiple		20%
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**20 to 25%**

ORNAMENTALS - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?:

Research is currently being conducted to identify potential alternatives.

ORNAMENTALS - 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

A number of technologies are currently being used in this sector, including integrated pest management, crop rotation, fallow periods, hand weeding, etc. However, these practices are still not sufficient to control the key target pests without the use of methyl bromide.

ORNAMENTALS - SUMMARY OF TECHNICAL FEASIBILITY

Without methyl bromide, certain growers will suffer both yield and quality losses. In addition growers who rotate several species of ornamentals on a particular field, need to kill crop residue from previous crops to eliminate contamination, as well as control other weeds and pathogens. Due to the diversity and complexity of the cut flower and foliage industry, an additional 2 to 3 years are needed to complete ongoing research into implementation of methyl bromide alternatives. Alternatives have not been found for all species. Some of the alternatives that have been found for other crops (such as 1,3-D for Easter lilies in Oregon) may not be feasible for floriculture in general because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, and buffer zone requirements. In addition, township caps limit the use of 1,3-Dichloropropene in California. Other alternatives provide inconsistent control or have restrictions that limit their use at this time. Growers also need time to transition to the alternatives.

In this industry, the fumigation situation and need for methyl bromide varies by species. Although there are some potential alternatives, there is not enough grower experience and research to justify to switching to alternatives by the 2006 growing season.

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.	Some growers have switched from a 98% MB formulation to a 67 % formulation.	Unknown.	unknown
WHAT FURTHER USE/EMISSION REDUCTION STEPS WILL BE TAKEN FOR THE METHYL BROMIDE USED FOR CRITICAL USES?	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try high density films.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try lowering methyl bromide dosages..	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try increasing the chloropicrin percentage.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try less frequent applications.
OTHER MEASURES *(please describe)*	Water seals of newer products	Unknown	Unknown	Unknown

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

In accordance with the criteria of the critical use exemption, each party is required to describe ways in which it strives to minimize use and emissions of methyl bromide. The use of methyl bromide in ornamental production in the United States is minimized in several ways. First, because of its toxicity, methyl bromide has, for the last 40 years, been regulated as a restricted use pesticide in the United States. As a consequence, methyl bromide can only be used by certified applicators that are trained at handling these hazardous pesticides. In practice, this means that methyl bromide is applied by a limited number of very experienced applicators with the knowledge and expertise to minimize dosage to the lowest level possible to achieve the needed results. In keeping with both local requirements to avoid "drift" of methyl bromide into inhabited areas, as well as to preserve methyl bromide and keep related emissions to the lowest level possible, methyl bromide application is most often machine injected into soil to specific depths.

As methyl bromide has become more scarce, users in the United States have, where possible, experimented with different mixes of methyl bromide and chloropicrin. Specifically, in the early 1990s, methyl bromide was typically sold and used in methyl bromide mixtures made up of 95%

methyl bromide and 5% chloropicrin, with the chloropicrin being included solely to give the chemical a smell enabling those in the area to be alerted if there was a risk. However, with the outset of very significant controls on methyl bromide, users have been experimenting with significant increases in the level of chloropicrin and reductions in the level of methyl bromide. While these new mixtures have generally been effective at controlling target pests, at low to moderate levels of infestation, it must be stressed that the long term efficacy of these mixtures is unknown.

Tarpaulin (high density polyethylene) is also used to minimize use and emissions of methyl bromide. In addition, cultural practices are utilized by ornamental growers.

Reduced methyl bromide concentrations in mixtures, cultural practices, and the extensive use of tarpaulins to cover land treated with methyl bromide has resulted in reduced emissions and an application rate that we believe is among the lowest in the world for the uses described in this nomination.

PART E: ECONOMIC ASSESSMENT

Please note that in this study net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation for an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income is smaller than the net revenue measured in this study, often substantially so. We did not include fixed costs because they are difficult to measure and verify.

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

ALTERNATIVE	YIELD*	COST IN YEAR 1 *(U.S.$/ha)*	COST IN YEAR 2 *(U.S.$/ha)*	COST IN YEAR 3 *(U.S.$/ha)*
Methyl Bromide	100	3,607	3,607	3,607
Dazomet	75	3,900	3,900	3,900
1,3-d + pic	75	3,500	3,500	3,500
Metam Sodium	80	3,607	3,607	3,607

** As percentage of typical or 3-year average yield, compared to methyl bromide*

22. GROSS AND NET REVENUE:

TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

YEAR 1		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
Methyl Bromide	25,918	11,257
Dazomet	18,467	3,933
1,3-d + pic	18,459	4,425
Metam Sodium	20,735	6,547

TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

YEAR 2		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
Methyl Bromide	25,918	11,257
Dazomet	18,467	3,933
1,3-d + pic	18,459	4,425
Metam Sodium	20,735	6,547

TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

Year 3		
Alternatives *(as shown in question 21)*	**Gross revenue for last reported year** *(U.S.$/ha)*	**Net Revenue for last reported year** *(U.S.$/ha)*
Methyl Bromide	25,918	11,257
Dazomet	18,467	3,933
1,3-d + pic	18,459	4,425
Metam Sodium	20,735	6,547

Measures of Economic Impacts of Methyl Bromide Alternatives

Cut Flowers - Table E.1: Economic Impacts of Methyl Bromide Alternatives

CUT FLOWERS	Methyl Bromide	Dazomet	1,3-D + Pic	Metam Sodium
Yield Loss (%)	0	25 %	25%	20%
Yield per Hectare	187	157	157	168
* Price per Unit (U.S.$)	138.38	131.46	131.46	138.38
= Gross Revenue per Hectare (U.S.$)	25,918	18,467	18,459	20,735
- Operating Costs per Hectare (U.S.$)	14,391	14,534	14034	14,188
= Net Revenue per Hectare (U.S.$)	11,527	3,933	4,425	6,547
1. Loss per Hectare (U.S.$)	$0	7,594	7,102	4,980
2. Loss per Kilogram of Methyl Bromide (U.S.$)	$0	16.94	15.84	11.11
3. Loss as a Percentage of Gross Revenue (%)	0%	29%	27%	19%
4. Loss as a Percentage of Net Revenue (%)	0%	66%	62%	43%

SUMMARY OF ECONOMIC FEASIBILITY

The economic analysis evaluated methyl bromide alternative control scenarios for cut flower production for Florida, and California by comparing the economic outcomes of methyl bromide oriented production systems to those using alternatives. However, due to the fact that there are over 100 species of ornamentals grown in all regions of the country, the data from these two examples are used to derive a proxy estimate for the entire industry.

The economic factors that most influence the feasibility of methyl bromide alternatives for fresh cut flower production are: (1) yield losses, referring to reductions in the quantity produced, (2) increased production costs, which may be due to the higher-cost of using an alternative, additional pest control requirements, and/or resulting shifts in other production or harvesting practices, and (3) missed market windows due to plant back time restrictions, which also affect the quantity and price received for the goods.

The economic reviewers analyzed crop budgets for pre-plant sectors to determine the likely economic impact if methyl bromide were unavailable. Various measures were used to quantify the impacts, including the following:

(1) **Loss per Hectare.** For crops, this measure is closely tied to income. It is relatively easy to measure, but may be difficult to interpret in isolation.

(2) **Loss per Kilogram of Methyl Bromide**. This measure indicates the nominal marginal value of methyl bromide to crop production.

(3) **Loss as a Percentage of Gross Revenue.** This measure has the advantage that gross revenues are usually easy to measure, at least over some unit, *e.g.*, a hectare of land or a storage operation. However, high value commodities or crops may provide high revenues but may also entail high costs. Losses of even a small percentage of gross revenues could have important impacts on the profitability of the activity.

(4) **Loss as a Percentage of Net Operating Revenue**. We define net cash revenues as gross revenues minus operating costs. This is a very good indicator as to the direct losses of income that may be suffered by the owners or operators of an enterprise. However, operating costs can often be difficult to measure and verify.

(5) **Operating Profit Margin**. We define operating profit margin to be net operating revenue divided by gross revenue per hectare. This measure would provide the best indication of the total impact of the loss of methyl bromide to an enterprise. Again, operating costs may be difficult to measure and fixed costs even more difficult, therefore fixed costs were not included in the analysis.

These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for methyl bromide users, who are producers in this case. Because producers (suppliers) represent an integral part of any definition of a market, we interpret the threshold of significant market disruption to be met if there is a significant impact on commodity suppliers using methyl bromide. The economic measures provide the basis for making that determination.

Several methodological approaches will help interpret the findings. Economic estimates were first calculated in pounds and acres and then converted to kilograms and hectares. Costs for alternatives are based on market prices for the control products multiplied by the number of pounds of active ingredient that would be applied. Baseline costs were based on the average number of annual applications necessary to treat cut flowers with methyl bromide.

Net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this study. Fixed costs were not included because they are difficult to measure and verify.

Loss per hectare measures the value of methyl bromide based on changes in operating costs and/or changes in yield. Loss expressed as a percentage of the gross revenue is based on the ratio of the revenue loss to the gross revenue. Likewise for the loss as a percentage of net revenue. The profit margin percentage is the ratio of net revenue to gross revenue per hectare. The values to estimate gross revenue and the operating costs for each alternative were derived for three alternative control scenarios for Florida and California, relative to methyl bromide: 1) Dazomet; 2) 1,3-d + chloropicrin; and 3) metam sodium. Yield loss estimates were based on data from the CUE's and U.S. EPA data, as well as expert opinion.

Regulatory constraints.
In California, 1,3-d plus chloropicrin would also be the primary replacement for methyl bromide. California restricts total use of 1,3-d, at the local level (township cap). In Florida, the use of 1,3-d also requires a 100-foot buffer around inhabited structures. This would reduce the production acreage an estimated 10%. Nematodes and weeds and pathogens are key pests in Florida and California bulb grower and are controlled with methyl bromide. Chloropicrin is not as effective in controlling weeds as methyl bromide. Using chloropicrin adds to production costs through increased chemical, weeding and labor costs.

Alternative 1 (Dazomet), yield loss was estimated to be 25%, and gross revenues are expected to decline 29% and prices offset by 05%, if growers miss key market windows. Buffer restrictions would also reduce gross revenues but the number of acres affected to estimate the impact is not available. The estimated net revenue is estimated to decline more than 66%. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $16.94 per kilogram.

Under alternative 2 (1,3-d plus chloropicrin), the yield loss was also estimated to be 25 % and prices offset by 05%, if growers miss key market windows due to increased re-entry interval time. Buffer restrictions would also reduce gross revenues but the number of acres affected to estimate the impact is not available. Gross revenue is expected to decline 27%. The net revenue is expected to decline by more than 62%. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $15.84 per kilogram.

Under alternative 3 (metam sodium), there is no expected plant back restriction as the re-entry interval increases by 2 days so the yield loss was estimated to be 20%, and the gross revenue loss was estimated to by 19%. The net revenue is expected to decline by more than 43%. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $11.11 per kilogram.

Note: Market price data was not available for the United States cut flower industry but it is assumed that the net effect of shifting from methyl bromide to any of the alternatives other than metam sodium would result in additional revenue reductions due fluctuations in market price due to changes in production and harvesting times.

It should be noted that the applicants do not consider any alternative to be feasible and that these estimates are an attempt to measure potential impacts.

PART F. FUTURE PLANS

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

Between 1992 and 2003, the California Cut Flower Commission has spent $260,000 in research related to methyl bromide alternatives in addition to hundreds of thousands of dollars spent by individual growers trying to find workable alternatives. Future research will focus on the following pests: weeds, *Fusarium oxysporum*, *Pythium* spp., *Meloidogyne* spp., and previous crop debris, such as bulblets, cormlets, etc. from crops such as callas, caladiums, and gladiolus. 1,3-D, metam sodium, dazomet, chloropicrin, and methyl iodide have already been tested. Future research will focus on methyl iodide, sodium azide, combinations of 1,3-D, metam sodium, and chloropicrin, and drip applied chloropicrin. The reason to transition away from methyl bromide has been ongoing for 10 years and should be completed by the end of 2006.

In Florida, research trials for 2003 are in place for caladiums in muck, aster, and snapdragons, and caladiums in sand are planned for 2004. Several alternatives will be tested, including metam sodium, 1,3-D/chloropicrin, iodomethane/chloropicrin, and sodium azide. In California, trials are in place or planned for callas, myrtle, ranunculus, liatris, freesia, and wax flower (at a minimum) for several alternatives. Additional funds ($90,000 for California researchers and an unknown amount for Florida) have just been made available via the IR-4 program to support new work in 2004.

The Agricultural Research Service (United States Department of Agriculture) has two full time employees (since 2000) working on methyl bromide alternatives for flowers and ornamentals. This represents about a $600,000 annual investment. In addition, a recent grant and other money, about $100,000 has provided two CCC grants for flower alternatives.

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 ornamentals research will require 4060 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 five year field study testing the comparative performance of methyl bromide, 1,3-D, metam sodium, and new reduced risk chemicals for control of soilborne pests with emphasis on nematodes and weeds.

24. How Do You Plan to Minimize the Use of Methyl Bromide for the Critical Use in the Future?

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?

26. Citations

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

Methyl Bromide Critical Use Exemption Process
2006 Methyl Bromide Usage Numerical Index (BUNI)

Date: 2/26/2004
Sector: ORNAMENTALS

Average Hectares in the US: not available
% of Average Hectares Requested: not available

2006 Amount of Request				2001 & 2002 Average Use*			Quarantine and Pre-Shipment	Regional Hectares**		
REGION	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)		2000 Data	% of 2000 Data	% of Requested Hectares
CUT FLOWERS AND FOLIAGE	226,796	578	392	60,747	150	404	0%	10,702	11%	5%
TOTAL OR AVERAGE	226,796	578	392	60,747	150	404	0%	10,702	11%	5%

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
CUT FLOWERS AND FOLIAGE	226,796	-	-	-	-	226,796	226,796	226,796	578	392	0%
Nomination Amount	226,796	226,796	226,796	226,796	226,796	226,796	226,796	226,796	578	392	0%
% Reduction from Initial Request	0%	0%	0%	0%	0%	0%	0%	0%	0%		

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
CUT FLOWERS AND FOLIAGE	392	392	0	0	0	0			44	31	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
CUT FLOWERS AND FOLIAGE													20% or 25% or 25%	Metam-Sodium or 1,3-D+Pic or Dazomet

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

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

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

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

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

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

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

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

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

APPENDIX B. SUMMARY OF NEW APPLICANTS

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

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

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

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

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

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

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

Appendix C – Key Pests of Select Cut Flower Species

The following list is not comprehensive, but is intended to demonstrate the complexity of the industry. In addition to the diseases and nematodes listed below, there are numerous weed species that are major problems in cut flower production. These species include the bulbs, tubers, or cormlets from a previous crop, yellow nutsedge (*Cyperus esculentus*), little mallow (*Malva parviflora*), and common sow thistle (*Sonchus oleracea*).

Diseases and Nematodes of cut flower crops currently controlled with Methyl Bromide.

Crop	Key Pests	Scientific name
Antirrhinum	Nematodes Pythium root rot	*Belanolaimus longidorus, Criconomella* spp., *Dolichodorus heterocephalus* *Pythium irregulare* (documented resistance to mefenoxam is 25-50%)
Calla lily	Erwinia soft rot Pythium root rot	*Erwinia carotovora* *Pythium* spp. (resistance to mefenoxam suspected to be widespread
Delphinium	Sclerotinia stem rot	*Sclerotinia* spp.
Dianthus	Fusarium wilt	*Fusarium oxysporum* fsp. *dianthii*
Eustoma	Fusarium wilt, root rot, and stem rot	*Fusarium oxysporum, F. solani,* and *F. avenaceaum*
Freesia	Fusarium wilt	*Fusarium* spp.
Gladiolus	Fusarium wilt Stromatinia neck rot	*Fusarium oxysporum* fsp. *gladioli* *Stromatinia gladioli*
Helianthus	Downy mildew	*Plasmopara halstedii* (this is a soil-borne pathogen)
Hypericum	Root knot nematode Pythium root rot	*Meloidogyne* spp. *Pythium* spp.
Iris	Fusarium wilt	*Fusarium oxysporum* fsp. *iridis*
Larkspur	Sclerotinia stem rot	*Sclerotinia sclerotiorum*
Liatris spicata	Sclerotinia stem rot	*Sclerotinia sclerotiorum*
Lilium	Pythium root rot	*Pythium* spp.
Matthiola	Sclerotinia stem rot Xanthomonas leaf spot	*Sclerotinia sclerotiorum* *Xanthomonas campestris* pv. *campestris*
Ranunculus	Pythium root rot Xanthomonas leaf spot	*Pythium* spp. *Xanthomonas campestris*