METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE ON STRAWBERRY NURSERIES 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 on Strawberries Nurseries Grown in Open Fields or in Protected Environments

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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 on Strawberry Nurseries in Open Fields or in Protected Environments

3. CROP AND SUMMARY OF CROP SYSTEM

Southeastern growers (Maryland, North Carolina, Tennessee) produce their transplants in open fields on an annual basis. Individual fields are only planted to strawberries once every three years. Approximately eighty-five percent of transplants produced are exported to Florida.

California growers produce their transplants over a five year cycle. Screenhouses are utilized during the first two years and open field plantings are used during the last three years. Methyl bromide is only needed in production years 2 thru 5. Individual planting sites are only planted to strawberries once every three years. The fourth and fifth production years account for 22 and 77 percent, respectively, of the current methyl bromide nursery usage in California. Transplants produced are distributed widely throughout the U.S. and other countries.

4. METHYL BROMIDE NOMINATED

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)	NOMINATION AREA (HA)
2006	**56,291**	**209**

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. strawberry nursery 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 tomato production.
- Quarantine and Pre-Shipment uses are not included in this CUE.

Methyl bromide is needed for strawberry nursery production to produce plants free of all damaging diseases and nematodes to meet state and foreign certification standards, as well as prospective buyer expectations. In addition to these certification-related pest control concerns, weed control is also essential to insure maximum runner production and prevent the spread of noxious weeds. The available alternatives have thus far not been found to provide acceptable levels of control of the key pests to depths of three feet. In addition, there are no markets for plants that do not meet the certification standards, which means that losses up to 100 percent are possible when less than required levels of pest control occur. Failure to adequately control pests in transplants would jeopardize the viability of the transplant and fruit production industries in the US, as well as the viability of fruit production in countries purchasing U.S. plants (e.g., Canada, Mexico, Spain, South America, and a number of other countries).

TABLE A.1: EXECUTIVE SUMMARY

Region		***Southeastern States***	***California***
AMOUNT OF NOMINATION			
2006	**Kilograms**	2,086	53,751
	Application Rate (kg/ha)	413	263
	Area (ha)	5	204
AMOUNT OF APPLICANT REQUEST			
2006	**Kilograms**	41,453	443,432
	Application Rate (kg/ha)	413	263
	Area (ha)	100	1,683
ECONOMICS FOR NEXT BEST ALTERNATIVE			
Marginal Strategy		1,3D+Pic	1,3D+Pic
Yield Loss (%)		10%	10%
Loss per hectare (US$/ha)		$5,469	$7,208
Loss per kg Methyl Bromide (US$/kg)		$13.26	$27.37
Loss as % of Gross Revenue (%)		13%	18%
Loss as % of Net Revenue (%)		46%	61%

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE

The key alternatives are 1,3-D/chloropicrin, 1,3-D/chloropicrin/metam-sodium, and 1,3-D/metam-sodium. None of these alternatives provide an adequate level of disease and nematode control throughout the root zone (up to 3 feet deep). Additionally, these alternatives generally provide little or no control of Yellow & Purple Nutsedge (Cyperus esculentus, C. rotundus) (SE States only) and a number of other critical weed pests in California (Table 10.1). The state certification requirements (references 7, 32a, 37a, 43a listed in section 26) associated with the requesting states are very high (virtually zero tolerance for any damaging diseases and plant-parasitic nematodes) in order to minimize the prospect of spreading these nematode and disease pests to other states and countries where these plants are shipped.

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

All growers in the affected states requesting methyl bromide use are dependent upon its wide pest spectrum and high level of pest control.

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 (%)
Southeastern States	Not Available	Not Available
California	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.

Not applicable**.** Please see the discussion of each alternative for a description of why it cannot be used under these situations.

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 applicable because the alternatives have not been proven effective for the control of the target pests under these conditions.

8. Amount of Methyl Bromide Requested for Critical Use

Southeastern States And California- Table 8.1: Amount of Methyl Bromide Requested for Critical Use

Region:	**SOUTHEASTERN STATES**	**CALIFORNIA**
Year of Exemption Request	**2006**	**2006**
Kilograms of Methyl Bromide	41,453	443,432
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)*	100 ha.	1,683 ha.
Application rate* *(kg/ha)* for the **formulation**	619	395
Application rate* *(kg/ha)* for **METHYL BROMIDE**	413	263
Dosage rate* *(g/m^2)* of **formulation** used to calculate requested kilograms of methyl bromide	61.9	39.5
Dosage rate* *(g/m^2)* of **METHYL BROMIDE**	41.3	26.3

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. Values greater than 100 percent are due to the inclusion of additional varieties in the applicant's request that were not included in the USDA National Agricultural Statistics Service surveys of the crop.
- 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. The two applicants that included growth in their request had the growth amount removed.
- There was a small adjustment for use rate in one of the applications.
- Quarantine and pre-shipment (QPS) hectares is the area in the applicant's request subject to QPS treatments. Both applicants had QPS listed the amount requested reflects the subtraction of the QPS amount.
- Only the acreage experiencing one or more of the following impacts were included in the nominated amount: moderate to heavy key pest pressure.

TABLE A.2: 2006 SECTOR NOMINATION—STRAWBERRY NURSERIES*

2006 Strawberry Nurseries Sector Nomination		Southeastern States	California
Applicant Request for 2006	Requested Hectares (ha)	100	1,683
	Requested Application Rate (kg/ha)	413	263
	Requested Kilograms (kg)	41,453	443,432
CUE Nominated for 2006	Nominated Hectares (ha)	5	204
	Nominated Application Rate (kg/ha)	413	263
	Nominated Kilograms (kg)	2,086	53,751

2006 Sector Nomination Totals	Overall reduction (%)	88%
	2006 U.S. CUE Nomination (kg)	**55,837**
	Research Amount (kg)	**454**
	Total 2006 U.S. Sector Nominated Kilograms (kg)	**56,291**

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

SOUTHEASTERN STATES - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

SOUTHEASTERN STATES - 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
Southeastern States	Weeds: Yellow nutsedge (*Cyperus esculentus*), Purple nutsedge (*Cyperus rotundus*) Diseases: Black root rot (*Rhizoctonia* and *Pythium spp.*); Crown rot (*Phytophthora cactorum*); root-knot nematodes (*Meloidogyne spp.*)	None of the available alternatives provide an acceptable level of control of nutsedge; the affected states' regulatory requirements to meet certification standards which amount to virtually complete control of fungal diseases and nematodes, is only attainable with methyl bromide

SOUTHEASTERN STATES - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

SOUTHEASTERN STATES - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	SOUTHEASTERN STATES
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Strawberry Transplants
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual crop, replanted in same site once every three years
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	Various crops planted
SOIL TYPES: *(Sand, loam, clay, etc.)*	93% medium and 7% light soils, containing up to 2% organic matter
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	Every year
OTHER RELEVANT FACTORS:	None identified

SOUTHEASTERN STATES - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(temperate,zones 6a to 8b)*	6a, 6b, 7a, 7b, 8a, 8b											
RAINFALL *(mm)*	163	124	109	87	78	146	113	202	109	116	54	76
OUTSIDE TEMP. *(℃)*	9.4	14.5	17.7	23.4	26	25.9	22.6	14.9	7.7	3.4	2.9	4.2
FUMIGATION SCHEDULE							X	X				
PLANTING SCHEDULE		X	X									
HARVEST SCHEDULE							2X	X				

* Macon, GA

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

None were identified as being limiting factors.

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

SOUTHEASTERN STATES - 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)*	82	82	82	55	67	71
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Virtually all flat fumigation	Virtually all flat fumigation	Virtually all flat fumigation	Virtually all flat fumigation	Virtually all flat fumigation	Virtually all flat fumigation
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	49,386	49,386	33,764	22,900	27,747	29,251
FORMULATIONS OF METHYL BROMIDE *(methyl bromide/ chloropicrin)*	98:2	98:2	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection
APPLICATION RATE OF FORMULATIONS IN kg/ha*	616	616	619	619	619	619
APPLICATION RATE OF METHYL BROMIDE IN kg/ha*	604	604	413	413	413	413
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	61.6	61.6	61.9	61.9	61.9	61.9
ACTUAL DOSAGE RATE OF METHYL BROMIDE *(g/m^2)**	60.4	60.4	41.3	41.3	41.3	41.3

** For flat fumigation treatment application rate and dosage rate may be the same.*

SOUTHEASTERN STATES - PART C: TECHNICAL VALIDATION

SOUTHEASTERN STATES - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

SOUTHEASTERN STATES – 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	Objectionable odors in residential areas; little or nor efficacy on nutsedge (Locascio 1997 & 1999); in some instances it caused increased emergence of nutsedge (Motis and Gilreath 2002); very unlikely that the near-perfect levels of disease and nematode control required by state certification programs cannot be attained throughout the 1 m. root zone. Chloropicrin is generally considered a good control measure for certain diseases (*Pythium, Phytophthora, Fusarium, Verticillium*), but is not generally considered very effective for nematode or weed control. See also chloropicrin issues addressed in the fumigant combination entries in this section.	No
NON CHEMICAL ALTERNATIVES		
Biofumigation	Lack of adequate data on the activity of biofumigation materials on nutsedge control; Based on studies with other crops, allelochemicals may cause phytotoxic effects (Norsworthy 2002; Johnson et al. 1993); very unlikely that the near-perfect level of disease and nematode control required by state certification programs can be attained throughout the 1m. deep root zone. Biofumigation is not technically feasible because it does not provide adequate control of target pests to produce a certifiable strawberry nursery stock. Research conducted in Florida showed some control of plant pathogens but no control of nematodes or weeds in the soil. In cases where biofumigation have been shown to control weeds, the data are mostly for small-seeded weed species that have small carbohydrate energy sources compared to nutsedge. The data on biofumigation are too limited to consider it as a practical alternative to methyl bromide. In addition, biofumigation is not technically feasible because the quantity of Brassica crop needed to control target pests would be approximately 3 hectares for every hectare of strawberry production. Incorporation of Brassica at these levels would be likely to have allelopathic effects on the target crop. In the Southeast, production field trials with cabbage residue and tomato produced inconsistent and inadequate efficacy, and poor yields in two years out of three. The yield losses could range from 0% - 50%.	No

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Solarization	Even in warmer climates (Georgia) it is impossible to attain temperatures lethal to nutsedge (50-55°C) at depths below 10 centimeters (Miles et. al. 2002); near-perfect level of disease and nematode control required by state certification programs very unlikely to be attained throughout the 1 m. deep root zone. Solarization is not a technically feasible alternative because it does not provide adequate control of target pests to produce certifiable strawberry nursery stock. Use of solarization is not practical due to the depth of heating required to eliminate viable weed seed, nematodes, and disease organisms. The time for solarization to raise soil temperatures to the level needed to kill soil pathogens in any strawberry nursery region is likely to also be the time when the crops themselves must complete their growth cycle. Unpredictable, stormy summer weather still creates risks and may damage mulch. In one Southeast field trial, solarization gave poor yields in two years out of three with losses ranging from 0% to 40%.	No
General IPM	Nothing available for control of nutsedge; near-perfect level of disease and nematode control required by state certification programs very unlikely to be attained throughout the 1 m. root zone. IPM, the use of pest monitoring activities coupled with chemical and non-chemical management tools, has been adopted for management of weed, diseases, and nematodes on many crops. However, problematic weeds like nutsedge and nightshade, and soilborne diseases and nematodes are not effectively controlled by these practices in strawberry nurseries. General IPM is being used in strawberry nursery stock production, but it is not technically feasible alone to provide adequate pest control. IPM practices include field sanitation to limit inoculum buildup, crop rotation to provide non host periods, and breeding for resistance to pathogens.	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Cover crops mulching	Cover crops/mulching is currently being used but it is not technically feasible as a complete replacement for methyl bromide to control the target pest and certify the nursery stock; level of disease and nematode control required by state certification programs cannot be attained. Cover crops/mulching is currently being used but it is not technically feasible as a complete replacement for methyl bromide to control the target pests and certify the nursery stock. The use of cover crops is a common practice to improve soil structure and suppress an array of soilborne pathogens. Cover crops and mulches have been integrated into strawberry nursery crop production systems. Some cover crops that have been shown to reduce weed populations also reduced or delayed crop maturity and/or emergence, as well as yields (Burgos et al., 1996; Galloway et al., 1996). Cowpea and sunn hemp have been shown to suppress nutsedge, but the effect is short lived, due to the weed's capacity for rapid tuber production. Allelochemicals released by some cover crops or organic mulches can injure crops (Johnson et al., 1993; Norsworthy, 2002).	No

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Crop rotation/fallow	Growers typically utilize this practice by growing other crops every 2 out of three years; this practice has not resulted in a level of disease and nematode control required by state certification programs throughout the 1 m. deep root zone; no suitable nutsedge controls available during production of the rotational crops (Culpepper 2002). A three-year crop rotation/fallow is being used in strawberry nursery stock production, but it is not technically feasible when used alone to control the key target pests. Although such crop rotation and fallow procedures are generally considered useful pest management tools for weeds, diseases and nematodes, they are rarely considered standalone control measures. Significantly longer time frames may produce higher levels of control for most pests, but are generally considered impractical because of limited land availability and high costs. There are registered herbicides that are effective for nutsedge control in agronomic crops. These herbicides are not available for most fruit or vegetable crops, and many of them have 12- to 26-month carryover restrictions for vegetable crops. Crop rotation and fallow will not suppress nutsedge. Johnson & Mullinix (1997) showed that uninterrupted plantings of peanut, corn, or cotton, with moderate levels of weed management suppressed yellow nutsedge in Georgia. Their data also showed an increase in nutsedge densities in fallow plots, likely due to the longevity of nutsedge tubers in soil, mild winters that prevent winter-kill of tubers, and the ability of tubers to regenerate with the long growing season in the southeastern coastal plain. There are also reports of increasing populations of yellow nutsedge in fallowed fields, even when weed control/management is performed. Since there are no herbicides registered for use on strawberry plants that will effectively control nutsedge, management of these weeds during short-term rotations and fallow is not effective.	No
Soilless culture	Soilless culture is not being used and it is not technically feasible because it requires a complete transformation of the U.S. production system. There are high costs associated with this as compared to current production practices. Soilless culture is not being used and it is not technically feasible because it requires a complete transformation of the U.S. production system. There are high costs associated with this as compared to current production practices. According to data provided by The National Center for Food and Agricultural Policy, a greenhouse typically costs between US$12.5 million and US$20 million per hectare. Although yields obtained through greenhouse production are higher than yields of the best growers, the issue of capitalization for this and other Sectors make the alternative not practically feasible as a near term strategy to reduce reliance on methyl bromide..	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Substrates/plug plants grown hydroponically	Even if effective, it would be cost prohibitive to change over to the required technology. Substrates/plug plants are currently being produced and sold in the southeast and to a very limited extent in California but this method alone does not provide pest control and would fail to produce a pest free product. Furthermore, this method would require extensive retooling by the nursery industry.	No
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin	Little or no efficacy on nutsedge (Locascio 1997 & 1999); level of disease and nematode control required by state certification programs cannot be attained throughout the 1 m. deep root zone; may be the best alternative where nutsedge is not a problem (50% of production area). The combination of 1,3-D and chloropicrin is not technically feasible because it does not adequately control nematodes and diseases to the level required by various state laws, and results in yield losses in nursery plants. 1,3 D provides good nematode control, only moderate disease control, and poor weed control. A 30.5 meter (100 feet) 1,3-D buffer requirement, to mitigate area resident exposure, would be particularly constraining on smaller fields in predominantly urban fringe areas, which is typical for the Southeastern U.S. growers. Personal Protective Equipment (PPE) requirements also limit operations that require workers in the field, particularly given the high temperatures which occur in the southeast, which are exacerbated by high humidity. Workers wearing the required Personal Protective Equipment become at risk for possible heat exhaustion or heat stroke. For example, PPE may require applicators to wear fully sealed suits, with respirators. Such suits do not have refrigeration components, and under conditions of high heat and humidity, rapidly become unbearable for a typical applicator. Growers believe that the requirements for buffers and PPE may make it impractical to adopt 1,3-D. The buffer requirements, especially for the small acreage farms in the Southeastern U.S., eliminate so much area around the perimeter of a field that there is very little left that can be treated using 1,3-D alone to grow strawberries. Chloropicrin provides good disease control, but poor nematode and weed control. Workers complain about eye and lung irritation when applying chloropicrin, which is virtually the same as tear gas.	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
1,3-D + chloropicrin + metam-sodium	Little or no efficacy on nutsedge; very unlikely that the near-perfect levels of disease and nematode control required by state certification programs cannot be attained throughout the 1 m. root zone. The combination of 1,3-D, chloropicrin and metam sodium is not technically feasible because it does not adequately control pests and diseases to the level required by various state laws, and therefore this decrease in efficacy results in yield losses in nursery plants. 1,3-D is a good nematicide and chloropicrin is a good fungicide. Metam sodium provides moderate but unpredictable disease, nematode, and weed control since it suffers from erratic efficacy, most likely due to irregular distribution of the product through soil. Metam sodium degrades in the soil to form methylisothiocyanate, which has activity against nematodes, fungi, insects, and weeds. Methyl bromide has a higher vapor pressure than metam sodium, therefore can penetrate and diffuse throughout the soil more effectively than metam sodium. In addition, the effectiveness of metam sodium is very dependent on the organic matter and moisture content of the soil. Studies to evaluate best delivery systems for metam sodium are being conducted. Some studies have shown that soil injections and drenches are more effective than drip irrigation. Research trials show that incorporation of metam sodium with a tractor-mounted tillovator provides good results but most growers do not have this equipment. A 3-week time interval before planting is required to avoid phytotoxic levels; causing delays in production schedules that could lead to missing specific market windows, thus reducing profit or actually causing a loss for a grower. The combination of the three chemicals would still require a companion herbicide or hand weeding. Failure to control the full spectrum of weeds could lead to increased disease pressure over time because the weeds can be reservoirs for disease or harbors insect vectors of disease. Also, in strawberry fruit production, there is demand for pest free strawberry root stock. The nursery growers who do not supply this type of product will be forced out of the market.	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
1,3-D + metam-sodium	1,3-D or metam-sodium possess little or no efficacy on nutsedge (Webster et. al. 2001); metam component is likely to provide inconsistent nematode, weed and disease control due to poor movement within soil; very unlikely that the near-perfect levels of disease and nematode control required by state certification programs can be attained with this combination throughout the 1 m. deep root zone. The combination of 1,3-D and metam sodium is not technically feasible because it does not adequately control pests and diseases to the level required by various state laws, and results in yield losses in nursery plants. 1,3-D is a good nematicide and metam sodium provides moderate but unpredictable disease, nematode, and weed control. As indicated above, metam also suffers from erratic efficacy, most likely due to irregular distribution of the product through soil. The combination of these chemicals would still require a companion herbicide or hand weeding. Failure to control the weed seed in soil would most likely lead to increased disease pressure over time. Also, in strawberry fruit production, there is demand for pest free strawberry root stock. The nursery growers who do not supply this type of product will be forced out of the market. As with the other suggested combinations (above) there are issues with the use of Personal Protective Equipment (PPE) in the hot or hot and humid climates of California and the southeastern U.S. In addition, the buffer requirement of 90 meters (300 feet) would be particularly constraining on smaller fields in predominantly urban fringe areas. For small strawberry nursery operations in the southeastern U.S., the 1,3-D buffer requirements eliminate a large area around the field perimeter which impacts the total acreage available for strawberry nursery production. Sequential application of each one of these chemicals requires significantly more time than using methyl bromide alone since growers must wait longer after fumigation to put the strawberry root stock in the ground. Growers have a greater planting delay for several weeks, which will extend their production schedule. This delay directly impacts cultivar options, Integrated Pest Management practices, timing of planting and harvest for strawberry fruit production, marketing window options, land leasing decisions, and subsequent crop rotation schedules. Since growers will require rootstock at a fixed time during the year, the nursery plants could be of lower grade and quality (smaller) causing loss to both the nursery grower and the fruit grower.	No

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

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

SOUTHEASTERN STATES – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
Other fungicides, herbicides, or nematicides.	There are no other pesticides (with the exception of iodomethane) in the registration process that can take the place of methyl bromide.

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

SOUTHEASTERN STATES – 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 for any crop uses in the US.	Yes	Unknown
Propargyl bromide	Registration in the U.S. has not yet been requested. Comparative performance data not presented in any of the studies submitted.	No	Unknown
Sodium azide	Registration in the U.S. has not yet been requested.	No	Unknown

SOUTHEASTERN STATES - 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

Preamble - The following is the only directly relevant study conducted thus far in the southeastern states. Another study conducted in 2003 is nearing completion. Neither study utilizes methyl bromide (MB) as the comparative treatment, but rather uses methyl iodide (MI) as the principal alternative and compares it to Telone C-35 and an untreated control. Based on researchers' opinions from numerous studies, MI when used as a soil fumigant generally provides yields and levels of pest control comparable to methyl bromide. Accordingly, we assumed that the results of the available study are representative of previous studies and can be relied upon for assessing the comparative value of the best available alternative (1,3-D + 35% chloropicrin).

Given the soil types present in production areas the root zone required to be protected is generally as deep as 3 feet. Although several of the alternatives provide adequate levels of pest control at shallower depths, none consistently provide suitable control levels at 3 feet. Failure to provide levels of pest control at the required depth will result in inadequate levels of control which will result in rejection of the plants produced under these conditions (100% loss in affected fields). Accordingly, the maximum loss estimate is listed as 100% because the various State certification requirements which equate to a zero tolerance for disease symptoms and nematodes.

SOUTHEASTERN STATES – TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES CERTAIN WEEDS

Treatment	Application Rate (kg/ha)	% MB Pest Control			% MB Yield	Comments
		Nem.	Dis.	Weeds		
Methyl Iodide (100%)	263	NQ	NQ	Assume 100%	Assume 100%	No methyl bromide tested
Methyl Iodide/Chloropicrin (75:25)	263/66	NQ	NQ	92%	81%	
1,3-D/Chloropicrin (Telone C-35)	254/139	NQ	NQ	87%	73%	

Source: Gilreath, J.P., E.B. Poling, J.W. Noling, 2001, unpublished study

Key to Table Abbreviations: NQ = not quantified (too low and non-uniform); Nem. = nematodes; Dis. = diseases

MI alone yield was statistically higher than the combination with chloropicrin (CP) and the 1,3-D/CP treatments. There was no statistical difference between these later two treatments, however, they both provided statistically higher yields than the untreated controls. The prominent weeds present were hairy galinsoga (Galinsoga cillata), carpetweed (Mollugo verticillata), and purslane (Portulaca oleracea). The most difficult weed to control was hairy galinsoga, with MI alone providing the highest levels of control of this as well as the other weeds. The post treatment disease and nematode incidence data were too variable and too low in any of the plots to formulate any conclusions. The yield benefit exhibited by MI is likely to be a combination of weed control plus control of other unidentified microbial pests. The comparative weed control percentages are based solely on control of hairy galinsoga. Note: Another similar study was initiated in 2003 and was near completion in December 2003.

SOUTHEASTERN STATES – TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D/chloropicrin (Telone C-35)	Certain Weeds (see above table)	0-27%	10%
Metam Sodium	Certain Weeds (see above table)		50%
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**10%**

SOUTHEASTERN STATES - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE

Iodomethane is in a pending registration status and is being evaluated as an alternative. It is generally considered to be as efficacious as methyl bromide for most preplant crop uses and virtually all pests. Growers can easily transition to this alternative.

Dazomet is also in a pending registration status as a nematicide on strawberries. Based on previous studies on other crops, it is reportedly not likely to be a suitable alternative for strawberry nurseries.

SOUTHEASTERN STATES - 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE

We are not aware of any that are feasible in the short run. The technology changeover costs for adopting soilless culture techniques are extremely high. Although yields reportedly obtained through greenhouse production are higher than that of the best conventional growers, the issue of capitalization for this and other sectors make the alternative not practically feasible as a near term strategy to reduce reliance on methyl bromide. No information was presented on the long term viability of this option. Reportedly, the organic strawberry fruit production growers are dependent upon methyl bromide treated transplants.

SOUTHEASTERN STATES - SUMMARY OF TECHNICAL FEASIBILITY

None are considered technically feasible at the present time due to the high levels of disease and nematode control required by the current state certification standards.

Since chloropicrin is virtually the same as tear gas worker eye irritation concerns exist for this option.

CALIFORNIA - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

CALIFORNIA - 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
California	Diseases: Phytophthora Crown and Root Rots (*Phytophthora spp.*); Red Stele (*Phytophthora fragariae*); Verticillium Wilt (*Verticillium dahliae*); and possibly others Nematodes: Root-knot (*Meloidogyne spp.*); sting (*Belonolaimus spp.*); dagger (*Xiphinema spp.*); lesion (*Pratylenchus spp.*); foliar (*Aphelenchoides spp.*); needle (*Longidorus spp.*); stem (*Ditylenchus spp.*) Weeds: numerous weeds listed (e.g., annual bluegrass, bur clover, carpetweed, chickweed, field bindweed, goat grass, hairy nightshade, lambsquarter, malva, nutsedge, pig weed, portulaca, prostate spurge, puncture vine, purslane, vetch)	The State mandatory certification program has strict requirements for control of diseases and nematodes which amount to virtually complete control of the key pests. Given the growing situations encountered over the course of the 5-year transplant production cycle (a different growing location is used each year), none of the alternatives have thus far been shown to be consistently perform at a highly effective level at soil depths to 3 feet. Methyl iodide is considered by most researchers to be viable potentially alternative, which is currently proposed for registration in the US.

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

CALIFORNIA - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	CALIFORNIA
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Strawberry transplants
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual crop, only planted in the same location once every three years
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	The principal rotational crops are endive, garlic, onion, horseradish, mint, alfalfa, sugarbeets, and potatoes.
SOIL TYPES: *(Sand, loam, clay, etc.)*	80 % light soils, 10% medium soils and 10% heavy soils; 70% with 2% or less organic matter
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	Every year
OTHER RELEVANT FACTORS:	No

CALIFORNIA (LOW ELEVATION AREAS; YEARS 3 & 4) -TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(e.g. temperate, tropical)*	6a, 6b, 7a, 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	X								
HARVEST SCHEDULE											X	

*For Fresno, California.

CALIFORNIA (HIGH ELEVATION AREAS; YEAR 5) -TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(e.g. temperate, tropical)*	6a, 6b, 7a, 9a, 9b											
FUMIGATION SCHEDULE						X	X					
PLANTING SCHEDULE		X										
HARVEST SCHEDULE							X	X	X			

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

None were identified as being limiting factors.

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

California - 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)*	1,128	1,153	1,267	1,283	1,295	1,477
Ratio of flat fumigation methyl bromide use to strip/bed use if strip treatment is used	All Flat fumigation	All Flat fumigation	All Flat fumigation	All Flat fumigation	All Flat fumigation	All Flat fumigation
Amount of methyl bromide active ingredient used *(total kg)*	308,860	313,200	341,230	337,604	341,022	389,069
Formulations of methyl bromide *(e.g. methyl bromide 98:2; methyl bromide /chloropicrin 70:30)*	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)*	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection	Flat fumigation soil injection
Application rate of formulations in kg/ha*	411	408	404	395	395	395
Application rate of methyl bromide in kg/ha*	274	272	269	263	263	263
Actual dosage rate of formulations *(g/m^2)**	41.1	40.8	40.4	39.5	39.5	39.5
Actual dosage rate of formulations *(g/m^2)**	27.4	27.2	26.9	26.3	26.3	26.3

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

California - Part C: Technical Validation

California - 13. Reason for Alternatives Not Being Feasible

California – Table 13.1: Reason for Alternatives Not Being Feasible

Please see the description of the alternatives not being feasible under the Southeastern U.S. above.

California - 14. List and Discuss Why Registered *(and Potential)* Pesticides and Herbicides Are Considered Not Effective as Technical Alternatives to Methyl Bromide

California – Table 14.1: Technically Infeasible Alternatives Discussion

Please see the description of the technically infeasible alternatives discussion under the Southeastern U.S. above.

California - 15. List Present *(and Possible Future)* Registration Status of Any Current and Potential Alternatives

California – Table 15.1: Present Registration Status of Alternatives

Name of Alternative	Present Registration Status *State if registered for this crop, registered for crop but use restricted, registered for other crops but not target crop, or not registered*	Registration Being Considered by National Authorities? (Y/N)	Date of Possible Future Registration:
Iodomethane	Not registered for any crop uses in the US. Generally considered an excellent potential alternative.	Yes	Unknown
Sodium Azide	Not submitted for registration. Comparative performance data not presented in any of the studies submitted.	No	Unknown
Propargyl bromide	Not submitted for registration.	No	Unknown

California - 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

Preamble – Although only several studies are represented in the Tables below, numerous studies have been conducted and referenced (see section 26) in the two applications (Southeastern States [MD, NC, TN], and California). Given all the permutations of edaphic and pest variables that exist in the production areas, it is of limited practical value to present a limited subset of the total number of studies as being indicative of the actual performance variability ranges of the alternatives. Given the time constraints associated with these requests, it is impossible to accurately present the finding of all relevant studies. However, after perusing a large number of these studies it is obvious that none of the alternatives can consistently provide sufficient control of the target pests (comparable to levels and frequency attained with methyl bromide (MB). This is especially true for those pests subject to the rigorous requirements of the State's nursery certification program (virtually a zero tolerance for symptoms of soilborne diseases and the presence of plant-parasitic nematodes in the soil). Even though most studies have shortcomings in terms of the procedures utilized and/or the information reported, the aggregate conclusion is that none of the chemical and/or non-chemical alternatives will consistently achieve levels of pest control comparable to methyl bromide.

When one takes into account that the five-year production system involves new planting sites each year, consistency is important in satisfying the needs of their international, interstate and intrastate customers. The inconsistency in performance of the alternatives most likely relates to the application methods, application rates, alternative(s) evaluates, formulations of alternatives utilized, soil conditions, and weather conditions which occurred, and pest species and levels present in tests.

Given the soil types present in production areas the root zone required to be protected is generally as deep as 3 feet. Although several of the alternatives provide adequate levels of pest control at shallower depths, none consistently provide suitable control levels at 3 feet. Failure to provide levels of pest control at the required depth will result in inadequate levels of control which will result in rejection of the plants produced under these conditions (100% loss in affected fields).

CALIFORNIA – TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – Chemical Alternatives to Methyl Bromide Fumigation – How Well Do They Work?

Treatment	Application Method & Rate (kg/ha)	Pest Control (% of MB)		Yield (% of MB)	Comments
		NEM	DIS.		
MB/CP (67:33)	MB: 246kg/ha; CP: 121 kg/ha; chisel injection & tarped	+	+	100	
1,3-D/CP (70:30)	1,3-D: 361 kg/ha; CP: 155 kg/ha; chisel injection & tarped	+	+	96	
Chloropicrin (CP)	95-189; and 190 and higher; chisel injection & tarped	+	+	89 (< 190kg/ha); 103 (>190 kg/ha)	Evaluated both low and high dosage rates
Metam Sodium	950 kg/ha; surface drench and tarped	+	+	92	
Dazomet	340 kg/ha; bdcst, tilled into soil, and tarped	+	+	95	
Enzone **(sodium tetra thiocarbonate)**	2.85 kg/ha tarped	+	+	80	Not registered for use on strawberries
UTC		+	+	70	

Source: Gubler, W.D., J.M. Duniway, and N. Welch. 1996. Chemical Alternatives to Methyl Bromide Fumigation – How Well Do They Work?

Key to Abbreviations: 1,3-D = 1,3-dichloropropene; MB = methyl bromide; CP = chloropicrin; MS = metam sodium; UTC = untreated control; Nem. = nematodes; Dis. = diseases; bdcst = broadcast application.

Watsonville, CA 1993 study using large-scale plots; low levels of Phytophthora crown and root rot, Verticillium wilt, and nematodes; one-year evaluation only

CALIFORNIA – TABLE 16.2: EFFECTIVENESS OF ALTERNATIVES Chloropicrin Effect on Weed Seed Viability.

Control Measures Evaluated	Application Method & Rate (kg/ha)	Weed Control (% of MB)	Comments
MB/CP (67:33)	MB: 225 kg/ha CP: 111 kg/ha; soil injection	100	Very good control of 3 weeds; no control of 2 weeds (mallow & filaree)
Metam Sodium (MS)	MS: 197 kg/ha; drip irrigation	Comp.	Very good control of 3 weeds; no control of 2 weeds (mallow & filaree)
MS plus CP	MS: 197kg /ha drip irrigation; CP: 83 – 220 kg/ha soil injection	Very Comp.	produced a slight increase in weed control over MS alone = best available treatment for the weed species present
Chloropicrin (CP)	CP: 83 – 220 kg/ha soil injection	Comp.	good control of 3 weeds at the higher rates; no control of 2 weeds (mallow & filaree)
UTC		none	

Source: Haar, M.J., S.A. Fennimore, H.A. Ajwa, C.Q. Winterbottom. 2003. Chloropicrin Effect on Weed Seed Viability.

Key to Abbreviations: CP = chloropicrin; MS = metam sodium; 1,3-D = 1,3-dichloropropene; UTC = untreated controls; Comp = comparable.

Study conducted over two years near Santa Maria, CA. Primary weed pests: Polygonum aviculare (knot-grass), Portulaca oleracea (common purslane) and Malva parviflora (little mallow) were introduced in both years, whereas, Stellaria media (chickweed) and Erodium cicutarium (red-stem filaree) were introduced in the second year; similar weed seed sensitivity for CP and MS; no yield data obtained.

CALIFORNIA – TABLE 16.3: EFFECTIVENESS OF ALTERNATIVES - Soil Fumigation and Runner Plant Production.

Treatment	Application Method & Rate (kg/ha)	Yield (% of MB)	Comments
Methyl bromide	Chisel	100 (4 trials)	
Chloropicrin	140-191 kg/ha , chisel	73-92 (3 trials)	
Chloropicrin	≥300 kg/ha, Chisel;	86 – 100 (4 trials)	Appeared to be the best of the alternatives evaluated
1,3-D/Chloropicrin (70:30)	Chisel;	84 (1 trial)	Did not rank very high as an alternative due to reduced plant growth and runner production
1,3-D/Chloropicrin (30:70)	Chisel	91 (1 trial)	Appeared to perform similar to the high rate of chloropicrin
UTC	Not Applicable	38-55 (4 trials)	

Source: Larson, K.D. and D.V. Shaw, 2000, Soil Fumigation and Runner Plant Production: A Synthesis of Four Years of Strawberry Nursery Field Trials, Hort Sci. 35 (4):642-646.
Key to Abbreviations: 1,3-D = 1,3-dichloropropene; UTC = untreated controls.

This study was conducted over four on former strawberry nursery soils, however, other crops planted in these soils prior to initiating this study; fumigants chiseled into soil at a 36 cm depth and covered with a tarp for 7 days; pest types and pressures uncertain, however, verticillium wilt (V. albo-atrum) was detected in some locations and roots were examined for decay and discoloration, with the untreated plants (UTC) exhibiting most of the disease symptoms; nematodes were not considered to be a problem in any of the test locations. It should be noted that the main focus of this study was to evaluate yield responses and that quantification of the various pest organisms was beyond the scope of this study.

CALIFORNIA – TABLE 16.4: EFFECTIVENESS OF ALTERNATIVES - Evaluation of Alternatives to Methyl Bromide for Soil Fumigation at Commercial Fruit and Nut Tree Nurseries

Treatment	Application Method & Rate (kg/ha)	Nematode Control (% of MB)
Methyl bromide /chloropicrin (75:25)	MB: 448 kg/ha; CP: 151 kg/ha	100
1,3-D/CP ???plus m-s???	1,3-D: 518 kg/ha; CP: 283 kg/ha	83-100
1,3-D + Metam Sodium	Sequential application; 1,3-D: 518 kg/ha; MS: ?? kg/ha.	16-100
1,3-D/dazomet	Sequential application; 396 kg/ha; 224 kg/ha DZ	28-100

Source: McKenry, M.V., 2001. Evaluation of Alternatives to Methyl Bromide for Soil Fumigation at Commercial Fruit and Nut Tree Nurseries, California Department of Pesticide Regulation (Contract # 99-0218).

Key to Abbreviations: 1,3-D = ; CP = ; MB = ;DZ = dazomet; Prominent nematode pests present: lesion (Pratylenchus spp.), spiral (Helicotylenchus dihystera), dagger (Xiphinema americanum) and some root-knot (Meloidogyne spp.)

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

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D/Chloropicrin	Certain weeds	0-27%	10%
1,3-D + Metam Sodium	Certain weeds	---	13%
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**10-13%**

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

California-Table 15.1 for status of iodomethane. This fumigant is unregistered, but is reported to be a potential suitable alternative for all key pests.

Dazomet is also in a pending registration status as a nematicide on strawberries. Based on previous studies on other crops, it is reportedly not likely to be a suitable methyl bromide alternative for strawberry nurseries.

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

We are not aware of any current or near future technologies that are technically and/ or economically feasible. Some people consider soilless hydroponic culture as a possible long-term option. Although this technique could eliminate all or most of the typical soilborne pests currently controlled by methyl bromide. However, new pests may become problematic, which may/may not be controllable with available pesticides.

CALIFORNIA - SUMMARY OF TECHNICAL FEASIBILITY

None are considered technically feasible at the present time due to the high levels of disease and nematode control required by the current state certification standards, which equate to virtually complete control of all damaging disease and nematode pests. Buffer zones and regulatory constraints are only secondary concerns, since none of the available alternatives can provide suitable pest control at root zone depths to 1 meter.

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.	Between 1997 and 2002 the dosage rate of methyl bromide has dropped by one eighth.	All use 67:33	Unidentified
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	Possible changeover from broadcast to raised bed band treatments,	Unidentified	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try less frequent applications.
OTHER MEASURES *(please describe)*	Examination of promising but presently unregistered alternative fumigants with non-chemical methods.	Unidentified	Unidentified	Unidentified

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 the growing of strawberry nurseries 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 who 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 for strawberry nurseries is most often machine injected into soil to specific depths.

As methyl bromide use has become scarcer, 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 strawberry nursery 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

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 *(US$/ha)*	COST IN YEAR 2 *(US$/ha)*	COST IN YEAR 3 *(US$/ha)*
Methyl Bromide	100	1,806	1,806	1,806
Metam Sodium	50	3,187	3,187	3,187
1,3-d+pic	90	4,774	4,774	4,774
Chloropicrin	95	5,419	5,419	5,419
1,3-d+Metam Sodium	86	5,317	5,317	5,317

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

CALIFORNIA-22. GROSS AND NET REVENUE

CALIFORNIA-TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

YEAR 1		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(US$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(US$/ha)*
Methyl Bromide	41,019	11,879
Metam Sodium	-	-
1,3-d+pic	36,918	4,670
Chloropicrin	38,968	8,112
1,3-d+Metam Sodium	35,892	5,137

CALIFORNIA-TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

YEAR 2		
ALTERNATIVES *(as shown in question 21)*	**GROSS REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*	**NET REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*
Methyl Bromide	41,019	11,879
Metam Sodium	-	-
1,3-d+pic	36,918	4,670
Chloropicrin	38,968	8,112
1,3-d+Metam Sodium	35,892	5,137

CALIFORNIA-TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

YEAR 3		
ALTERNATIVES *(as shown in question 21)*	**GROSS REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*	**NET REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*
Methyl Bromide	41,019	11,879
Metam Sodium	-	-
1,3-d+pic	36,918	4,670
Chloropicrin	38,968	8,112
1,3-d+Metam Sodium	35,892	5,137

SOUTHEASTERN STATES-22. GROSS AND NET REVENUE

SOUTHEASTERN STATES-TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

YEAR 1		
ALTERNATIVES *(as shown in question 21)*	**GROSS REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*	**NET REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*
Methyl Bromide	42,008	11,763
Metam Sodium	21,004	-8,923
1,3-d+pic	37,807	6,294
Chloropicrin	39,907	7,749
1,3-d+Metam Sodium	-	-

SOUTHEASTERN STATES-TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

YEAR 2		
ALTERNATIVES *(as shown in question 21)*	**GROSS REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*	**NET REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*
Methyl Bromide	42,008	11,763
Metam Sodium	21,004	-8,923
1,3-d+pic	37,807	6,294
Chloropicrin	39,907	7,749
1,3-d+Metam Sodium	-	-

SOUTHEASTERN STATES-TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

YEAR 3		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(US$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(US$/ha)*
Methyl Bromide	42,008	11,763
Metam Sodium	21,004	-8,923
1,3-d+pic	37,807	6,294
Chloropicrin	39,907	7,749
1,3-d+Metam Sodium	-	-

SOUTHEASTERN STATES - TABLE E.1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEASTERN STATES	METHYL BROMIDE	ALTERNATIVE METAM	ALTERNATIVE 1,3-D+PIC
YIELD LOSS (%)	0	50	10
YIELD PER HECTARE (PLANTS)	211,715	105,857	190,543
* PRICE PER UNIT (US$)	.20	.20	.20
= GROSS REVENUE PER HECTARE (US$)	42,008	21,004	37,807
- OPERATING COSTS PER HECTARE (US$)	30,245	29,927	31,513
= NET REVENUE PER HECTARE (US$)	11,763	-8,923	6,294
LOSS MEASURE			
1. LOSS PER HECTARE (US$)	$0	$20,686	$5,469
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	50.15	13.26
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	49%	13%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	176%	46%

CALIFORNIA - TABLE E.2: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA	METHYL BROMIDE	ALTERNATIVE 1,3-D METAM	ALTERNATIVE 1,3-D+PIC
YIELD LOSS (%)	0	13%	10%
YIELD PER HECTARE (BOXES)	332	291	299
* PRICE PER UNIT (US$)	50	50	50
= GROSS REVENUE PER HECTARE (US$)	41,019	35,892	36,918
- OPERATING COSTS PER HECTARE (US$)	29,141	30,755	32,247
= NET REVENUE PER HECTARE (US$)	11,879	5,137	4,670
LOSS MEASURES			
1. LOSS PER HECTARE (US$)	$0	6,741	7,208
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	25.59	27.37
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	16%	18%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	57%	61%

SUMMARY OF ECONOMIC FEASIBILITY

The economic analysis compared the costs of methyl bromide alternative control scenarios for the Southeastern Strawberry Consortium and the California Strawberry Growers Association to the baseline costs for methyl bromide. The economic estimates were first calculated in pounds and acres and then converted to kilograms and hectares. The costs for the alternatives are based on market price for the control products multiplied by the number of pounds of active ingredient that would be applied. The baseline costs were based on the average number of applications to treat strawberry plants (boxes) with methyl bromide per year. The loss per hectare measures the value of methyl bromide based on changes in operating costs and/or changes in yield. The 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 derive gross revenue and the operating costs for each alternative were derived from the baseline methyl bromide costs compared to the costs of changes under three fumigation scenarios in the Southeastern States: 1) metam sodium; 2) 1,3-d + chloropicrin; and 3) chloropicrin.

For California, the baseline methyl bromide costs were compared to three scenarios: 1) 1,3-d + metam sodium; 2) 1,3-d + chloropicrin; and 3) chloropicrin. The differences in the cost of production were primarily attributable to changes in fumigation costs.

One of the issues facing nursery growers is that pest infestation can wipe out production for the season. If there are quality concerns such as disease, weeds, or insect infestation growers will not be able to market their seedlings. Fruit producers are not willing to purchase plants that have any visual symptoms of disease and may hold the nursery responsible for any disease that shows up during fruiting in the field in the first weeks after planting. Nearly a billion plants are produced by the California strawberry nursery system alone each year and this production is distributed world-wide. There are approximately 13 seedling/runner producers in California that must manage disease incidence over the 4 year production cycle of the strawberry stock. Without data to illustrate the impacts of a growers stock being wiped out, we assumed that if an estimated 10% of the root-stock is contaminated this would directly reduce the yield by that amount. Clearly this would have a detrimental impact on the entire industry as the yield losses would be in addition to the yield losses generated by the change to alternative chemical controls. Yield losses on a hectare basis could range from 15-60% reflecting lower yields from alternative control and loss of the nursery supply. However, a more likely scenario is that several growers in a region would suffer pathogen or insect infestation and that the entire stock for those growers cannot be marketed, yield losses would be much higher.

Southeastern States:
Under Alternative 1 (Metam sodium), yield loss was estimated to be 50%, which translates into a 49% loss in gross revenues. With operating costs in U.S. dollars per hectare of $29,927, the estimated net revenue was -$8,923 per hectare, or a loss of 176%. The loss per hectare is estimated to be $20,686. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $50.15 per kilogram.

Under alternative 2 (1,3-d + chloropicrin), the yield loss was estimated to be 10% and the loss a percent of gross revenue was 13%. Operating costs in U.S. dollars per hectare are $31,513. The estimated net revenue was $6,294 per hectare, or a loss of 46%. The loss per hectare is estimated to be $5,469. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $13.26 per kilogram.

Under alternative 3 (chloropicrin alone), the yield loss was estimated to be 5%. Operating costs in U.S. dollars per hectare are $32,158. The estimated net revenue was $7,749 per hectare. The loss per hectare is estimated to be $4,014. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $9.73 per kilogram.

California:
Alternative 1 (Metam sodium), yield was assumed to be 13% with operating costs in U.S. dollars per hectare of $30,755. The estimated net revenue was $5,137 per hectare. The loss per hectare is estimated to be $6,741. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $25.59 per kilogram.

Under alternative 2 (1,3-d +chloropicrin), the yield loss was estimated to be 10%. Operating costs in U.S. dollars per hectare are $32,247. The estimated net revenue was $4,670 per hectare. The loss per hectare is estimated to be $7,208. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $27.37 per kilogram.

Under alternative 3 (chloropicrin), the yield loss was estimated to be 5%. Operating costs in U.S. dollars per hectare are $30,856. The estimated net revenue was $8,112 per hectare. The loss per hectare is estimated to be $3,766. The loss per kilogram of methyl bromide in U.S. dollars is estimated to be $14.30 per kilogram.

PART F. FUTURE PLANS

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

The available alternatives are currently all considered unsuitable. Continued testing for 5 to 10 years may be required to explore new or improved application techniques that may be considered suitable. Combinations of several chemical and non-chemical controls may ultimately be needed along with application technique changes.

Since 1997, the United States EPA has made the registration of alternatives to methyl bromide a high registration priority. Because the EPA currently has more applications pending in its registration review queue than the resources to evaluate them, EPA prioritizes the applications. By virtue of being a top registration priority, methyl bromide alternatives enter the science review process as soon as U.S. EPA receives the application and supporting data rather than waiting in turn for the EPA to initiate its review.

As one incentive for the pesticide industry to develop alternatives to methyl bromide, the Agency has worked to reduce the burdens on data generation, to the extent feasible while still ensuring that the Agency's registration decisions meet the Federal statutory safety standards. Where appropriate from a scientific standpoint, the Agency has refined the data requirements for a given pesticide application, allowing a shortening of the research and development process for the methyl bromide alternative. Furthermore, Agency scientists routinely meet with prospective methyl bromide alternative applicants, counseling them through the preregistration process to increase the probability that the data is done right the first time and rework delays are minimized

The U.S. EPA has also co-chaired the USDA/EPA Methyl Bromide Alternatives Work Group since 1993 to help coordinate research, development and the registration of viable alternatives. This coordination has resulted in key registration issues (such as worker and bystander exposure through volatilization, township caps and drinking water concerns) being directly addressed through USDA's Agricultural Research Service's U.S.$15 million per year research program conducted at more than 20 field evaluation facilities across the country. Also EPA's participation in the evaluation of research grant proposals each year for USDA's U.S.$2.5 million per year methyl bromide alternatives research has further ensured close coordination between the U.S. government and the research community.

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 strawberry nurseries research will require 454 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 three year study testing the comparative performance of methyl bromide, alternative fumigants, preplant fungicide dips, post plant fungicides, germplasm, microbial inoculants, and cultural practices. 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 strawberry nurseries research will require 454 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 three year study testing the comparative performance of methyl bromide, alternative fumigants, preplant fungicide dips, post plant fungicides, germplasm, microbial inoculants, and cultural practices

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?

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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:**	**STRAWBERRY NURSERY**	**% 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)		2001 & 2002 Average	% of 2001 & 2002 Average	% of Requested Hectares
CALIFORNIA	443,432	1,683	263	365,045	1,386	263	85%	not available	not available	not available
SOUTHEASTERN US	41,453	100	413	28,499	69	413	89%	not available	not available	not available
TOTAL OR AVERAGE	484,884	1,784	338	393,544	1,455	338	87%	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
CALIFORNIA	443,432	-	85,094	-	304,587	53,751	53,751	53,751	204	263	88%
SOUTHEASTERN US	41,453	-	22,489	-	16,878	2,086	2,086	2,086	5	413	95%
Nomination Amount	484,884	484,884	377,301	377,301	55,837	55,837	55,837	55,837	209	267	88%
% Reduction from Initial Request	0%	0%	22%	22%	88%	88%	88%	88%	88%		

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
CALIFORNIA	263	263	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%
SOUTHEASTERN US	413	413	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
CALIFORNIA	No	Yes	Yes	Tarp	Yes	+	Yes						10% or 13 %	1,3-D + Pic or 1,3-D + Metam
SOUTHEASTERN US	No	Yes	Yes	Tarp	Yes	+	Yes						10%	1,3-D + Pic

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**