METHYL BROMIDE CRITICAL USE RENOMINATION FOR PREPLANT SOIL USE (OPEN FIELD OR PROTECTED ENVIRONMENT)

NOMINATING PARTY:
The United States of America

NAME:
USA CUN09 SOIL STRAWBERRY NURSERY STOCK Open Field

BRIEF DESCRIPTIVE TITLE OF NOMINATION:
Methyl Bromide Critical Use Nomination for Preplant Soil Use for Strawberry Nursery Stock (Runners) Grown in Open Fields or Protected Environments (Submitted in 2007 for 2009 Use Season)

CROP NAME (OPEN FIELD OR PROTECTED):
Strawberry Nursery Stock (Runners) in Open Fields or Protected Environments

QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION:

TABLE COVER SHEET: QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION

YEAR	NOMINATION AMOUNT (METRIC TONNES)*
2009	**8.837**

*This amount includes methyl bromide needed for research.

SUMMARY OF ANY SIGNIFICANT CHANGES SINCE SUBMISSION OF PREVIOUS NOMINATIONS

Research for the strawberry nursery industries in California and Southeastern U.S. is showing that while alternatives may have the potential to replace methyl bromide it is necessary to continue additional research to verify trial results. Regulatory issues for use of 1,3-D, chloropicrin, and some low permeable films make methyl bromide critical for some nurseries. The industry continues to refine protocols for effective alternatives but this requires several seasons of data gathering. For example, the use of 1,3 w/chloropicrin or chloropicrin followed by dazomet appeared more effective in nursery trials in California (Kabir et al., 2005) than previous nursery trials where chloropicrin was applied alone (Larson and Shaw, 2000). Through optimizing research results alternative strategies can be identified. The current CUN indicates the continued critical need for methyl bromide for some part of the strawberry nursery industry.

REASONS WHY ALTERNATIVES TO METHYL BROMIDE ARE NOT TECHNICALLY AND ECONOMICALLY FEASIBLE

For the 2009 season, methyl bromide is critical for strawberry nurseries to produce plants free of 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 use protocols for the available alternatives have not been developed sufficiently to provide effective control of the key pests to depths of 1 meter. In addition, there are no markets for plants that do not meet the certification standards, which mean that losses up to 100% are possible when inadequate pest control occurs. Failure to adequately manage pests in transplants will jeopardize the viability of the transplant and fruit production industries in the U.S., as well as the viability of fruit production in countries purchasing U.S. plants (e.g., Canada, Mexico, Spain, countries in South America, and some others).

The key alternatives appear to be 1,3-dichloropropene (1,3-D)/chloropicrin, 1,3-D/chloropicrin/metam-sodium, 1,3-D/metam-sodium, and dazomet as a follow-up application to 1,3-D/chloropicrin or chloropicrin. These chemicals, in addition to other strategies, such as use of low permeability tarps, may ultimately reduce or replace methyl bromide. However, to maintain certification quality protocols for effective use of these alternatives have not been sufficiently developed to provide adequate disease and nematode control throughout the root zone. Additionally, these alternatives will require further study to show their consistency in providing control of yellow and purple nutsedge (*Cyperus esculentus*, *C. rotundus*) (primarily for the Southeastern nurseries) and a number of other critical weed pests in California.

The certification requirements (e.g., CDFA, 2003; NCDA, undated) associated with the requesting states are strict (zero tolerance for any damaging diseases and plant-parasitic nematodes) in order to minimize the prospect of spreading these nematode and diseases to other states and countries where these plants are shipped. For example, "When nursery stock in the nursery is found by the inspector to be infested with any plant pest, the certificate may not be issued until the infested stock has been treated or destroyed to the extent that the salable stock to be covered by the certificate shall be apparently free of plant pests" (NCDA, undated). Research has been cited (e.g., Kabir et al., 2005) in this review that indicates potentially effective alternatives, but the need for methyl bromide for 2009 is critical until alternatives have been sufficiently tested for use in commercial strawberry nursery operations.

(Details on this page are requested under Decision Ex. I/4(7), for posting on the Ozone Secretariat website under Decision Ex. I/4(8).)

This form is to be used by holders of single-year exemptions to reapply for a subsequent year's exemption (for example, a Party holding a single-year exemption for 2005 and/or 2006 seeking further exemptions for 2007). It does not replace the format for requesting a critical-use exemption for the first time.

In assessing nominations submitted in this format, TEAP and MBTOC will also refer to the original nomination on which the Party's first-year exemption was approved, as well as any supplementary information provided by the Party in relation to that original nomination. As this earlier information is retained by MBTOC, a Party need not re-submit that earlier information.

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. ☐ Yes ☐ No

______________________ ______________________ ______________

Signature Name Date

Title: ____

CONTACT OR EXPERT(S) FOR FURTHER TECHNICAL DETAILS:

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

1. PAPER DOCUMENTS: **Title of paper documents and appendices**	**No. of pages**	**Date sent to Ozone Secretariat**
USA CUN09 SOIL STRAWBERRY NURSERY STOCK Open Field		
2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: ***Title of each electronic file (for naming convention see notes above)**	**No. of kilobytes**	**Date sent to Ozone Secretariat**
USA CUN09 SOIL STRAWBERRY NURSERY STOCK Open Field		

* Identical to paper documents

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Part A: INTRODUCTION
Renomination Part A: SUMMARY INFORMATION

1. (Renomination Form 1.) NOMINATING PARTY AND NAME:
The United States of America
USA CUN09 SOIL STRAWBERRY NURSERY STOCK (RUNNERS) Open Field or Protected Environment

2. (Renomination Form 2.) DESCRIPTIVE TITLE OF NOMINATION:
Methyl Bromide Critical Use Nomination for Preplant Soil Use for Strawberry Nursery Stock (Runners) Grown in Open Fields or Protected Environments (Submitted in 2007 for 2009 Use Season)

3. CROP AND SUMMARY OF CROP SYSTEM (*e.g. open field (including tunnels added after treatment), permanent glasshouses (enclosed), open ended polyhouses, others (describe)*):

Southeastern U.S. nurseries (Maryland, North Carolina, and Tennessee) produce transplants in open fields. An individual field is planted to strawberries once every three years. Approximately 85% of transplants produced are sent to Florida.

California nurseries produce their transplants over a five-year cycle. Screenhouses are used during the first two years and open field plantings are used during the last three years. Methyl bromide is needed in production Years 2 thru 5. Individual planting sites are planted to strawberries once every three years. The fourth and fifth production years account for 22% and 77%, respectively, of the current methyl bromide nursery usage in California. Transplants produced are distributed widely throughout the U.S. and other countries. [Please see Appendix B for a detailed description of the California strawberry nursery industry.]

4. AMOUNT OF METHYL BROMIDE NOMINATED (*give quantity requested (metric tonnes) and years of nomination*):
(Renomination Form 3.) YEAR FOR WHICH EXEMPTION SOUGHT:

TABLE A 1: QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION

YEAR	NOMINATION AMOUNT (METRIC TONNES)*
2009	**8.837**

*This amount includes methyl bromide needed for research.

(Renomination Form 4.) SUMMARY OF ANY SIGNIFICANT CHANGES SINCE SUBMISSION OF PREVIOUS NOMINATIONS *(e.g. changes to requested exemption quantities, successful trialling or commercialisation of alternatives, etc.)*

Research to identify effective alternatives for the strawberry runner industries has made progress. Reports of ongoing research (e.g., Kabir et al., 2005) in California suggest that alternatives may be effective in some nurseries. Research trials indicated that iodomethane with chloropicrin, chloropicrin followed by dazomet, and 1,3-D with chloropicrin followed by dazomet are potentially effective alternatives to methyl bromide. Transitioning to these alternatives will require addressing regulatory issues (e.g., iodomethane is available for research use only; chloropicrin at high rates is restricted in California) and certification requirements. Consequently, while research indicates the possibility of effective alternatives for this industry, the U.S. nomination reflects the continued need for some methyl bromide for the 2009 use season.

5. (i) BRIEF SUMMARY OF THE NEED FOR METHYL BROMIDE AS A CRITICAL USE *(e.g. no registered pesticides or alternative processes for the particular circumstance, plantback period too long, lack of accessibility to glasshouse, unusual pests)*:

For the 2009 season, methyl bromide is critical for strawberry nurseries to produce plants free of diseases and nematodes to meet state and foreign certification standards, as well as prospective buyer expectations. Nevertheless, California has reduced their methyl bromide request substantially from previous years. Protocols to implement use of the best available alternatives have not been developed sufficiently to provide effective control of the key pests to depths of 1 m. In addition, there are no markets for plants that do not meet the certification standards, which mean that losses up to 100% are possible when inadequate pest control occurs. Failure to adequately manage pests in transplants will jeopardize the viability of the transplant and fruit production industries in the U.S., as well as the viability of fruit production in countries purchasing U.S. plants (e.g., Canada, Mexico, Spain, countries in South America, and some others).

A recent example of complications from contaminated nursery stock was reported by extension specialists in Florida (Noling, 2006). Florida purchases transplants not only from southeastern nurseries, but also from Canada. A severe outbreak of Golden Nematodes found on potatoes in Quebec province resulted in a quarantine in August, 2006 by USDA of all plant material from Quebec province into the U.S. Subsequent negotiations resulted in protocols to attempt to prevent transmitting the pathogen to the U.S. so that Florida strawberry farmers could import and plant their crops. The quarantine by USDA initially affected 30 million bare-root transplants and 3 million plug plants destined for Florida farms, which could have reduced plantings in Florida by 20%. Ultimately the problem was resolved by strict certification requirements. The situation highlights the implications of potentially contaminated nursery stock and consequences for nurseries and farms within the U.S. The critical need for methyl bromide for strawberry nurseries is reflected in the U.S. nomination for this sector for 2009.

TABLE A 2: EXECUTIVE SUMMARY*

Region		CA Strawberry Nursery Assoc.	SE Strawberry Consortium	Sector Total or Average
EPA Preliminary Value	kgs	4,690	39,624	44,314
EPA Amount of All Adjustments	kgs	-	(35,931)	(35,931)
Most Likely Impact Value for Treated Area	kgs	4,690	3,693	8,383
	ha	18	11	28
	Rate	263	350	296
Sector Research Amount (kgs)		454	2009 Total US Sector Nomination	8,837

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

(ii) STATE WHETHER THE USE COVERED BY A CERTIFICIATION STANDARD. (*Please provide a copy of the certification standard and give basis of standard (e.g. industry standard, federal legislation etc.). Is methyl bromide-based treatment required exclusively to meet the standard or are alternative treatments permitted? Is there a minimum use rate for methyl bromide? Provide data which shows that alternatives can or cannot achieve disease tolerances or other measures that form the basis of the certification standard).*

Nurseries providing strawberry plants for propagation or for fruit production are required to receive certification of pest-free status. Certification requirements are strict. For example, "When nursery stock in the nursery is found by the inspector to be infested with any plant pest, the certificate may not be issued until the infested stock has been treated or destroyed to the extent that the salable stock to be covered by the certificate shall be apparently free of plant pests" (NCDA, undated). Strawberry nurseries are required to produce pest-free plants to meet certification (e.g., CDFA, 2003; NCDA, undated) and quality standards. There are no markets for runners that do not meet the certification standards. Failure to adequately manage pests in transplants will jeopardize fruit production in the U.S.

6. SUMMARISE WHY KEY ALTERNATIVES ARE NOT FEASIBLE *(Summary should address why the two to three best identified alternatives are not suitable, < 200 words)*:

For the 2009 season, methyl bromide is critical for strawberry nurseries to produce pest-free plants to meet certification (e.g., CDFA, 2003; NCDA, undated) and quality standards. There are no markets for runners that do not meet the certification standards. Failure to adequately manage pests in transplants will jeopardize fruit production in the U.S.

Key alternatives are combinations of 1,3-dichloropropene (1,3-D), chloropicrin, metam-sodium, and dazomet. These chemicals and other strategies, such as use of low permeability tarps, may reduce or replace methyl bromide. To maintain certification quality protocols for effective use of these alternatives have not been sufficiently developed to provide adequate disease and nematode control throughout the root zone.

Research (e.g., Kabir et al., 2005) indicates potentially effective alternatives, but the need for methyl bromide for 2009 is critical until alternatives have been sufficiently tested for use in commercial strawberry nursery operations.

7. (i) PROPORTION OF CROP GROWN USING METHYL BROMIDE *(provide local data as well as national figures. Crop should be defined carefully so that it refers specifically to that which uses or used methyl bromide. For instance processing tomato crops should be distinguished from round tomatoes destined for the fresh market)*:

TABLE A 3. PROPORTION OF CROP GROWN USING METHYL BROMIDE

REGION WHERE METHYL BROMIDE USE IS REQUESTED	TOTAL CROP AREA 2001/2003 (HA)	PROPORTION OF TOTAL CROP AREA TREATED WITH METHYL BROMIDE (%)
Southeastern States	69	100
California	1,386	100

(ii) IF 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.

Pest-free standards for nursery stock make complete transition to alternatives difficult.

(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?

Until protocols have been tested confirming research results of effective alternatives, commercial nurseries will not be able to risk strawberry stock. Certification requirements make transitioning to alternatives more time consuming since long-term field trials have to be conducted.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE (*Duplicate table if a number of different methyl bromide formulations are being requested and/or the request is for more than one specified region*):

TABLE A 4. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION	Southeastern U.S.	California
YEAR OF EXEMPTION REQUEST—2009		
QUANTITY OF METHYL BROMIDE NOMINATED (METRIC TONNES)	See Appendix A	See Appendix A
TOTAL CROP AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/PIC FORMULATION (M^2 OR HA) (NOTE: IGNORE REDUCTIONS FOR STRIP TREATMENT)	See Appendix A	See Appendix A
METHYL BROMIDE USE: **BROADACRE OR STRIP/BED** TREATMENT?	Strip/Flat	Flat
PROPORTION OF BROADACRE AREA WHICH IS TREATED IN STRIPS; E.G. 0.54, 0.67	50%	N/A
FORMULATION (RATIO OF METHYL BROMIDE/PIC MIXTURE) TO BE USED FOR CALCULATION OF THE CUE E.G. 98:2, 50:50	67:33	67:33
APPLICATION RATE* (KG/HA) FOR THE FORMULATION	See Appendix A	See Appendix A
DOSAGE RATE* (G/M^2) (I.E. ACTUAL RATE OF FORMULATION APPLIED TO THE AREA TREATED WITH METHYL BROMIDE/PIC ONLY)	See Appendix A	See Appendix A

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

9. SUMMARISE ASSUMPTIONS USED TO CALCULATE METHYL BROMIDE QUANTITY NOMINATED FOR EACH REGION *(include any available data on historical levels of use):*

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 applicant that included growth in their request had the growth amount removed.
- Quarantine and pre-shipment (QPS) hectares is the area in the applicant's request subject to QPS treatments.
- Only the hectares affected by one or more of the following impacts were included in the nominated amount: moderate to heavy key pest pressure, regulatory impacts, karst topographic features, buffer zones, unsuitable terrain, and cold soil temperatures.

Renomination Form Part G: CHANGES TO QUANTITY OF METHYL BROMIDE REQUESTED

This section seeks information on any changes to the Party's requested exemption quantity.

(Renomination Form 16.) CHANGES IN USAGE REQUIREMENTS

Provide information on the nature of changes in usage requirements, including whether it is a change in dosage rates, the number of hectares or cubic metres to which the methyl bromide is to be applied, and/or any other relevant factors causing the changes.

A transition rate was applied based on the best estimate of yield losses and feasibility associated with likely methyl bromide alternatives that could be made by USG biologists and economists. In addition, a dosage rate of 150 kg/ha (for areas where disease pathogens were considered to be key pests) and 175 kg/ha (for areas where weeds were considered to be key pests) was used in calculating the amount of methyl bromide requested.

(Renomination Form 17.) RESULTANT CHANGES TO REQUESTED EXEMPTION QUANTITIES

QUANTITY (KG) REQUESTED FOR PREVIOUS NOMINATION YEAR:	8,838
QUANTITY (KG) APPROVED BY PARTIES FOR PREVIOUS NOMINATION YEAR:	8,838
QUANTITY (KG) REQUIRED FOR YEAR TO WHICH THIS REAPPLICATION REFERS:	8,837
TREATED AREA (HA) REQUIRED FOR YEAR TO WHICH THIS REAPPLICATION REFERS	See Appendix A

Part B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASON FOR THIS REQUEST IN EACH REGION (*List only those target weeds and pests for which methyl bromide is the only feasible alternative and for which CUE is being requested*):

TABLE B 1. KEY DISEASES AND WEEDS

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY DISEASE(S) AND WEED(S) TO SPECIES AND, IF KNOWN, TO LEVEL OF RACE	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; NO HOST RESISTANCE FOR A SPECIFIC RACE)
Southeastern Strawberry Nurseries	**Weeds**: Yellow nutsedge (*Cyperus esculentus*) and Purple nutsedge (*Cyperus rotundus*) (50%) **Diseases**: Black root rot (*Rhizoctonia* and *Pythium* spp.) (100%); Crown rot (*Phytophthora cactorum*) (<5%); **Nematodes**: root-knot nematodes (*Meloidogyne* spp.) (100%)	The major issue for pest management in the nursery is the zero-tolerance threshold for pests (e.g., NCDA, undated). To meet certification and production requirements, methyl bromide is critical for the portion of nursery land that cannot accomplish certification otherwise.
California Strawberry Nurseries	**Diseases**: Phytophthora Crown and Root Rots (*Phytophthora spp.*); Red Stele (*Phytophthora fragariae*); Verticillium Wilt (*Verticillium dahliae*); Anthracnose (*Colletotrechum acutatum*) **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 certification program has strict requirements for control of diseases and nematodes (CDFA, 2003). Given the growing situations encountered over the course of the 5-year transplant production cycle (a different growing location is used each year), in situations where 1,3-D is not effective, no other alternatives have been shown to provide pest control acceptable for state certification. There is research being conducted that indicates potential for acceptable alternatives in the future (e.g., Kabir et al., 2005) but additional research is needed to verify trial results. Methyl iodide may prove to be an effective alternative, but it is currently not registered in the U.S.

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

TABLE B 2. CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	REGION WHERE METHYL BROMIDE IS REQUESTED	
	SOUTHEASTERN U.S.	CALIFORNIA*
CROP TYPE, E.G. TRANSPLANTS, BULBS, TREES OR CUTTINGS	Strawberry transplants	Strawberry transplants
ANNUAL OR PERENNIAL CROP (STATE NUMBER OF YEARS BETWEEN REPLANTING)	Annual crop, replanted in same site once every three years	Annual crop, only planted in the same location once every three years
`YPICAL CROP ROTATION (IF ANY) AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION (IF ANY)	Various crops planted	The principal rotational crops are grains, or fallow, for two years. Usually, incorporated for increased organic matter. May also include, endive, garlic, onions, horseradish, and mint.
SOIL TYPES: (SAND LOAM, CLAY, ETC.)	93% medium and 7% light soils, containing up to 2% organic matter	80% light soils, 10% medium soils and 10% heavy soils; 70% with 2% or less organic matter
TYPICAL DATES OF PLANTING AND HARVEST	Plant: April/May Harvest: Sept/Oct	**Low elevation**: Planting: May/June Harvest: January **High elevation**: Planting: April Harvest: Sept-Nov
TYPICAL DATES OF METHYL BROMIDE FUMIGATION	Sept/Oct	April (low elevation); Aug/Sept (high elevation)
FREQUENCY OF METHYL BROMIDE FUMIGATION (E.G. EVERY TWO YEARS)	Prior to planting	Prior to planting
TYPICAL SOIL TEMPERATURE RANGE DURING METHYL BROMIDE FUMIGATION (E.G. 15-20°C)	Various	Various
CLIMATIC ZONE (E.G. TEMPERATE, TROPICAL)	6a, 6b, 7a, 7b, 8a, 8b	6a, 6b, 7a, 9a, 9b
ANNUAL AND SEASONAL RAINFALL (MM)	78-163 (Macon, Georgia)	0-72 mm (Fresno, California)
RANGE IN AVERAGE TEMPERATURE VARIATIONS IN MID WINTER AND MID SUMMER (E.G. MIN/MAX °C) (E.G. JAN 5-15°C, JULY 10-30°C	3-26 (Macon, Georgia)	Various
OTHER RELEVANT FACTORS:	None identified	None identified

*See Appendix B for an in-depth description of the nursery cropping system.

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

Soil structure and texture can impact transition to alternatives (e.g., metam-sodium does not consistently dissipate in heavy soils due to low vapour pressure). Delay in planting can occur with some alternatives due to longer fumigation time required under tarp. This could lead to smaller less vigorous strawberry transplants being available for sale.

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

(*Add separate table for each major region specified in Question 8*):

TABLE B 3 A. SOUTHEASTERN U.S.- HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2000	2001	2002	2003	2004	2005
AREA TREATED *(hectares)*	55	67	71	75	83	92
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	Strip (50%)	Strip (50%)	Strip (50%)	Strip (50%)	Strip (50%)	Strip (50%)
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	22,900	27,747	29,251	30,923	34,433	37,943
FORMULATIONS OF METHYL BROMIDE	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED)	Shank injected					
APPLICATION RATE OF ACTIVE INGREDIENT (kg/ha)*	413	413	413	413	413	413
ACTUAL DOSAGE RATE OF ACTIVE *(g/m^2)**	41.3	41.3	41.3	41.3	41.3	41.3

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

TABLE B 3 B CALIFORNIA - HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2000	2001	2002	2003	2004	2005
AREA TREATED *(hectares)*	1,283	1,295	1,477	1,550	1,683	1,698
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	Flat					
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	337,604	341,022	389,069	408,523	443,432	447,457
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected					
APPLICATION RATE OF ACTIVE INGREDIENT (kg/ha)*	263	263	263	263	263	263
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	26.3	26.3	26.3	26.3	26.3	26.3

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

Part C: TECHNICAL VALIDATION
Renomination Form Part D: REGISTRATION OF ALTERNATIVES

13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE (*Provide detailed information on a minimum of the best two or three alternatives as identified and evaluated by the Party, and summary response data where available for other alternatives (for assistance on potential alternatives refer to MBTOC Assessment reports, available at http://www.unep.org/ozone/teap/MBTOC , other published literature on methyl bromide alternatives and Ozone Secretariat alternatives when available)*:

TABLE C 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?
NON-CHEMICAL ALTERNATIVES		
General IPM	IPM, the use of pest monitoring activities coupled with chemical and non-chemical management tools, has been adopted already for management of weed, diseases, and nematodes in most nurseries. General IPM is being used in strawberry nursery stock production, but it is not feasible alone to provide adequate pest control. IPM practices include field sanitation to limit inoculum buildup, crop rotation or fallow to provide non host periods, cover crops, mulching, and breeding for resistance to pathogens.	Not applicable
Plug plants	Substrates/plug plants are currently being produced and sold in the southeast and to a limited extent in California, approximately 1% from plugs (Larson et al., 2002). Experience in California suggests variable successes, with some farmers pleased with earlier yields with plugs and others displeased by poorer fruit quality. Another problem, for high elevation nurseries at least, is distance and transportation to markets and questionable ablility to produce the required billion transplants per year. Until there are more consistent results methyl bromide will still be required by at least some nurseries.	If demand exists; for high elevation nurseries in California, transportation costs can be prohibitive.
CHEMICAL ALTERNATIVES		

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) followed by metam-sodium or dazomet; Chloropicrin followed by dazomet	Good results have been associated with use in some nursery studies in California (Kabir et al., 2003, 2005). Weeds and pathogen management yielded at least comparable marketable runner yields when compared to methyl bromide treatments. However, these were small-scale tests and confirmation of results will be required prior to industry adoption of this treatment. In addition, there are regulatory constraints for use of chloropicrin in California. Regulatory restrictions on use of 1,3-D and chloropicrin in California make these alternatives unavailable to some nurseries. It is unclear if alternative would be effective in southeast nurseries. Research with tarps and other combination strategies may improve efficacy (e.g., Kabir et al., 2005), but these need to be sufficiently developed for commercial use. 1,3-D is a good nematicide and chloropicrin is a good fungicide. Metam sodium or dazomet provide moderate, but in some situations, inconsistent disease, nematode, and weed control, dependent on soil conditions. Treatment with 1,3-D and/or chloropicrin followed by dazomet has achieved some success in California research trials. 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 many growers do not have this equipment. A 3-week time interval before planting is required to avoid phytotoxic levels. This can cause delays in production schedules that could lead to missing specific market windows, thus reducing profit or causing a loss for a grower. Personal Protective Equipment (PPE) requirements may be problematic for worker comfort in hot or humid climates of California or 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 area available for strawberry nursery production. Sequential application 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 may have a greater planting delay for several weeks, which will extend their production schedule. This delay may impact cultivar options, Integrated Pest Management practices, timing of planting and harvest, marketing window options, land leasing decisions, and subsequent crop rotation schedules. Since growers will require rootstock at a fixed time during the year, nursery plants could be smaller causing loss to both the nursery grower and the fruit grower.	Where proven effective

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

14. LIST AND DISCUSS WHY REGISTERED PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE (*Provide information on a minimum of two best alternatives and summary response data where available for other alternatives)*:

See Section 13, above.

15. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED (*Use the same regions as in Section 10 and provide a separate table for each target pest or disease for which methyl bromide is considered critical. Provide information in relation to a minimum of the best two or three alternatives.*)

TABLE C 2. FRUIT YIELD (GRAMS PER PLANT) OF STRAWBERRY AT WATSONVILLE, CA IN 2002.

Nursery treatment (high elevation, MacDoel, CA)	Field treatment (Watsonville)	Marketable fruit yield (g/plant)	Unmarketable fruit yield (g/plant)	Total fruit yield (g/plant)
control	Pic	1301.7	535.6	1837.3
MB/Pic	Pic	1235.8	550.9	1786.6
MI/Pic	Pic	1278.2	525.0	1803.3
Pic followed by dazomet	Pic	1388.4	575.1	1963.4
Telone C35 followed by dazomet	Pic	1346.4	553.3	1899.7
control	MB/Pic	1520.3	600.1	2120.4
MB/Pic	MB/Pic	1474.0	596.3	2070.3
MI/Pic	MB/Pic	1526.8	625.0	2151.8
Pic followed by dazomet	MB/Pic	1634.5	640.6	2275.1
Telone C35 followed by dazomet	MB/Pic	1434.1	634.0	2068.1
ANOVA		------------------------P values----------------------		
Nursery		0.04*	0.24	0.07
Field		<0.0001*	<0.0001*	<0.0001*
Nursery (field)		0.47	0.74	0.73

* indicates significance

[The ‘nursery’ column indicates the treatment of nursery plants grown in 2001; the ‘field’ column indicates the fumigation treatment in the field.]

Source: Kabir, Z., Fennimore, S., Martin, F., Ajwa, H., Duniway, J., Browne, G., Winterbottom, C., Westerdahl, B., Goodhue, R., Guerrero, L., Haar, M. 2003. Alternative[s] Fumigants for the Control of Soil Pests: Strawberry as a Model System. Methyl Bromide Alternatives Conference (2003). www.mbao.org. Similar results of ongoing studies were published by Kabir et al. (2005).

Key to Abbreviations: For **nursery treatments**: **control**= no fumigation; **methyl bromide/chloropicrin (MB/Pic)** = 57:43, 450 kg/ha; **methyl iodide/chloropicrin (MI/Pic)** = 50:50, 392 kg/ha; **1,3-D/chloropicrin (Telone C35)** (300 liters/ha) followed by **dazomet (280 kg/ha)**; **chloropicrin (Pic)** (336 kg/ha) followed by **dazomet** (280 kg/ha).

For **field treatments**: **control**= no fumigation; **MB/Pic**, 67:33 (392 kg/ha); **Pic** (224 kg/ha).

Table C 3. FRUIT YIELD (GRAMS PER PLANT) OF STRAWBERRY AT WATSONVILLE, CA IN 2003.

Nursery treatment (high elevation, MacDoel, CA)	Field treatment (Watsonville)	Marketable fruit yield (g/plant)	Unmarketable fruit yield (g/plant)	Total fruit yield (g/plant)
control	Pic	1270.2	1092.5	2362.7
MB/Pic	Pic	1244.2	1070.5	2314.7
MI/Pic	Pic	1153.7	992.9	2146.6
Pic followed by dazomet	Pic	1324.6	1059.4	2384.0
Telone C35 followed by dazomet	Pic	1220.2	1069.7	2289.9
control	MB/Pic	1177.2	1216.1	2393.3
MB/Pic	MB/Pic	1132.2	1179.8	2311.9
MI/Pic	MB/Pic	1050.8	1106.2	2157.0
Pic followed by dazomet	MB/Pic	1166.9	1249.2	2416.0
Telone C35 followed by dazomet	MB/Pic	1111.0	1176.9	2287.9
ANOVA		------------------------P values---------------------		
Nursery		0.001*	0.003*	0.0001*
Field		<0.0001*	<0.0001*	0.70
Nursery (field)		0.92	0.60	0.99

* indicates statistical significance
[The 'nursery' column indicates the treatment of nursery plants grown in 2002; the 'field' column indicates the fumigation treatment in the field.]
Source: Kabir, Z., Fennimore, S., Martin, F., Ajwa, H., Duniway, J., Browne, G., Winterbottom, C., Westerdahl, B., Goodhue, R., Guerrero, L., Haar, M. 2003. Alternative[s] Fumigants for the Control of Soil Pests: Strawberry as a Model System. Methyl Bromide Alternatives Conference (2003). www.mbao.org. Similar results of ongoing studies were published by Kabir et al. (2005).
Key to Abbreviations: For **nursery treatments**: **control**= no fumigation; **methyl bromide/chloropicrin (MB/Pic)** = 57:43, 450 kg/ha; **methyl iodide/chloropicrin (MI/Pic)** = 50:50, 392 kg/ha; **1,3-D/chloropicrin (Telone C35)** (300 liters/ha) followed by **dazomet (280 kg/ha)**; **chloropicrin (Pic)** (336 kg/ha) followed by **dazomet** (280 kg/ha). For **field treatments**: **control**= no fumigation; **MB/Pic**, 67:33 (392 kg/ha); **Pic** (224 kg/ha).

This strawberry yield research study was conducted at three strawberry runner nurseries. Plants were grown for three years at two high elevation nurseries (HEN) or for two years at a low elevation nursery (LEN). Plants were then placed in two different field locations (Watsonville and Oxnard) for marketable yield assessments. Plants received various fumigation treatments at both nursery and field locations (results from two trials, conducted in 2002 and 2003, are presented in Tables C2 and C3, above).

Pests were not identified and only yields were evaluated. In the 2002 test, "…fruit yield was significantly greater under the on-site MBPic treatment than in Pic treatment alone" (Table C3). The fumigants used at the nursery had "…positive carryover effects on marketable fruit yield when the treatment was Pic [followed by] Basamid".

The results at the Watsonville location for the 2003 test showed "…marketable fruit yield was increased (9%) in on-site Pic treatments compared to MBPic treatments. In contrast, non-marketable fruit yield was significantly greater (4%) under MBPic than under Pic (Table C3). The authors again noted that the nursery treatments had significant carryover effects on the fruit yield. They "…suggest that application of Pic fb [followed by] Basamid [dazomet] at the HEN increased runner plant production, which eventually improved fruit yield with Pic in the fruiting field. Pic could be a viable alternative to methyl bromide plus chloropicrin". No interaction was found between the fumigations at the nursery and field, therefore, the effects were considered additive.

16. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT THAT THE PARTY IS AWARE OF WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE? (*If so, please specify*):

There are a number of possibilities, including both chemical and non-chemical alternatives, which are being investigated for use as possible methyl bromide replacements. These range from iodomethane, which has some potential to become a drop-in replacement for methyl bromide in pre-plant uses, to radio waves which may one day be used to sterilize the soil.

Methyl iodide (iodomethane): Only has an 'experimental use permit' that allows field trials on about 2,000 acres (combined) of several crops (none of which are strawberry nursery).

Propargyl bromide: Under proprietary development for future registration submission.

Sodium azide: Under proprietary development for future registration submission.

Furfural: registered for greenhouse ornamentals only. Under proprietary development for other registration submission.

DMDS (dimethyl disulfide): Under proprietary development for future registration submission.

Until a chemical is registered, and only after efficacy against key pests is demonstrated in repeated trials at commercial scales, does the USG consider that a chemical or technology is a bona fide replacement for methyl bromide.

Protocols of the already identified alternatives (1,3-dichloropicrin, chloropicrin, dazomet, and metam-sodium) are being developed, primarily to identify the most effective combination or sequence of applications (e.g., chloropicrin followed by dazomet—see Kabir, et al., 2005).

17. (i) ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WITHOUT METHYL BROMIDE? *(e.g. soilless systems, plug plants, containerised plants. State proportion of crop already grown in such systems nationally and if any constraints exist to adoption of these systems to replace methyl bromide use. State whether such technologies could replace a proportion of proposed methyl bromide use):*

Plug plants are produced by a portion of the industry (in California, approximately 1% of transplants are plugs; see Larson et al., 2002). Alternative fumigants and combinations with IPM are being studied, but certification requirements demand that alternative technologies be proven prior to adoption by the industry.

(ii) IF SOILLESS SYSTEMS ARE CONSIDERED FEASIBLE, STATE PROPORTION OF CROP BEING PRODUCED IN SOILLESS SYSTEMS WITHIN REGION APPLYING FOR THE NOMINATION AND NATIONALLY:

Plug plant production is developing for some sector of the strawberry industry. Only about 1% of transplants used in the largest market, California, are produced as plugs (Larson et al., 2002). This has been a developing industry, but inconsistency of results has reduced demand. Some growers in California have been pleased with early planting with plugs, but others found the fruit quality was diminished (Larson et al., 2002). In addition, transportation costs to growers from remote high elevation nurseries reduce profits. Some nursery managers in California believe that the billion transplants required per year cannot reliably be produced by plug technology.

(iii) WHY ARE SOILESS SYSTEMS NOT A SUITABLE ALTERNATIVE TO PRODUCE THE CROP IN THE NOMINATION?

See Section 17 (ii), above.

Progress in registration of a product will often be beyond the control of an individual exemption holder as the registration process may be undertaken by the manufacturer or supplier of the product. The speed with which registration applications are processed also can falls outside the exemption holder's control, resting with the nominating Party. Consequently, this section requests the nominating Party to report on any efforts it has taken to assist the registration process, but noting that the scope for expediting registration will vary from Party to Party.

(Renomination Form 11.) PROGRESS IN REGISTRATION
Where the original nomination identified that an alternative's registration was pending, but it was anticipated that one would be subsequently registered, provide information on progress with its registration. Where applicable, include any efforts by the Party to "fast track" or otherwise assist the registration of the alternative.

USG endeavors to identify methyl bromide alternatives in order to move them forward in the registration queue. However USG has no legal authority to compel registrations; it can only act on registrations requested by private entities. The timely submission of data to support a registration decision is at the sole discretion of the registrant. Please see table below.

TABLE C 4. PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Methyl Iodide (MeI) (Iodomethane)	Not registered for use in U.S. Research label has been granted for small plots (approximately 1 ha). Formulation being considered is 50:50 (chloropicrin). Risk assessment for chloropicrin will have to be finalized prior to registration of MeI.	Yes	Unknown

(Renomination Form 12.) DELAYS IN REGISTRATION

Where significant delays or obstacles have been encountered to the anticipated registration of an alternative, the exemption holder should identify the scope for any new/alternative efforts that could be undertaken to maintain the momentum of transition efforts, and identify a time frame for undertaking such efforts.

USG has no legal authority to compel registrations; it can only act on registrations requested by private entities. The timely submission of data to support a registration decision is at the sole discretion of the registrant. Please see table above for additional detail.

(Renomination Form 13.) DEREGISTRATION OF ALTERNATIVES

Describe new regulatory constraints that limit the availability of alternatives. For example, changes in buffer zones, new township caps, new safety requirements (affecting costs and feasibility), and new environmental restrictions such as to protect ground water or other natural resources.

Six fumigants are undergoing a review of risks and benefits at present. A likely outcome of this review will be the imposition of additional restriction on the use of some or all of these chemicals. This process will not lead to proposed restrictions until 2008, at which point the process to modify labels will start. This process can take several years to complete. It is not possible to forecast the outcome of the soil fumigant analysis at this time.

An additional complication in forecasting changes in the registration of alternatives is that under the US federal system individual states may impose restrictions above those imposed at the Federal level. Examples of these additional restrictions include the township caps on Telone® in California and the “SLN” (Special Local Needs) restrictions on the same chemical in 31 Florida counties.

In addition, the California Department of Pesticide Regulation (DPR) may impose use restrictions and water seal requirements on all soil fumigants to reduce their contributions to volatile organic compounds as part of the efforts to meet the Federal Clean Air Standards for ground level ozone. DPR plans to finalize regulations in the next 2-3 months to meet a deadline imposed by a lawsuit concerning compliance with the 1994 pesticide component of the State Implementation Plan (SIP) on ozone. They are also in the process of devising what measures will be included in the next SIP (for June, 2007) to meet the new lower ozone standards.

Part D: EMISSION CONTROL
Renomination Form Part E: IMPLEMENTATION OF MBTOC/TEAP RECOMMENDATIONS

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

TABLE D 1. TECHNIQUES TO MINIMIZE USE AND EMISSIONS.

TECHNIQUE OR STEP TAKEN	LOW PERMEABILITY BARRIER FILMS	METHYL BROMIDE DOSAGE REDUCTION	INCREASED % CHLOROPICRIN IN METHYL BROMIDE FORMULATION	DEEP INJECTION	LESS FREQUENT APPLICATION
WHAT USE/EMISSION REDUCTION METHODS ARE PRESENTLY ADOPTED?	Currently, most growers use HDPE tarps; VIF is restricted in California.	Between 1997 and 2002 the dosage rate of methyl bromide has dropped by one eighth.	May be feasible for some pests, if regulations allow a higher percentage of chloropicrin	Deep injections are currently being used to provide the deep-rooted plant optimal pest-free environment	For certification of nursery stock, fumigation must occur prior to every planting
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,	May be feasible for some pests, if regulations allow a higher percentage of chloropicrin	Deep injections are currently being used to provide the deep-rooted plant optimal pest-free environment	For certification of nursery stock, fumigation must occur prior to every planting
OTHER MEASURES (PLEASE DESCRIBE)	Combination of methods using two or three chemicals and effective tarps (low permeability and/or various colors) and IPM methods are being studied to develop the most effective regimes for pest management.				

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

Techniques to minimize emission include the use of low-permeability films, the application of water seals, and the "top dressing" application of fertilizer. In California, however, there is a performance standard for films that require a minimum level of permeability to methyl bromide to protect workers so low barrier films cannot be used with methyl bromide.

The application of water seals is dependent on the availability of adequate supplies of water and a lack of restrictions on water use as well as irrigation systems that will allow the application of sufficient quantities of water to effect the seal.

In addition, practices such as deep injection are used by strawberry nursery growers to reduce the methyl bromide rates required for growing nursery stock.

The Methyl Bromide Technical Options Committee and the Technology and Economic Assessment Panel may recommended that a Party explore and, where appropriate, implement alternative systems for deployment of alternatives or reduction of methyl bromide emissions.

Where the exemptions granted by a previous Meeting of the Parties included conditions (for example, where the Parties approved a reduced quantity for a nomination), the exemption holder should report on progress in exploring or implementing recommendations.

Information on any trialling or other exploration of particular alternatives identified in TEAP recommendations should be addressed in Part C.

(RENOMINATION FORM 14.) USE/EMISSION MINIMISATION MEASURES

Where a condition requested the testing of an alternative or adoption of an emission or use minimisation measure, information is needed on the status of efforts to implement the recommendation. Information should also be provided on any resultant decrease in the exemption quantity arising if the recommendations have been successfully implemented. Information is required on what actions are being, or will be, undertaken to address any delays or obstacles that have prevented implementation.

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 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 tomatoes 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 98% methyl bromide and 2% 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 tomato 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.

USDA has several grant programs that support research into overcoming obstacles that have prevented the implementation of methyl bromide alternatives. In addition, USEPA and USDA jointly fund an annual meeting on methyl bromide alternatives. At this year's meeting (held in November in Orlando, Florida) sessions were to assess and prioritize research needs and to develop a use/emission minimization agenda for methyl bromide alternatives research.

Additional specific measures are provided in Table D 1.

Part E: ECONOMIC ASSESSMENT

20. (Renomination Form 15.) ECONOMIC INFEASIBILITY OF ALTERNATIVES – METHODOLOGY *(MBTOC will assess economic infeasibility based on the methodology submitted by the nominating Party. Partial budget analysis showing per hectare gross and net returns for methyl bromide and the next best alternatives is a widely accepted approach. Analysis should be supported by discussions identifying what costs and revenues change and why. The following measures may be useful descriptors of the economic outcome using methyl bromide or alternatives. Parties may identify additional measures. Regardless of the measures used by the methodology, it is important to state why the Party has concluded that a particular level of the measure demonstrates a lack of economic feasibility):*

The following measures or indicators may be used as a guide for providing such a description:

(a) The purchase cost per kilogram of methyl bromide and of the alternative;
(b) Gross and net revenue with and without methyl bromide, and with the next best alternative;
(c) Percentage change in gross revenues if alternatives are used;
(d) Absolute losses per hectare relative to methyl bromide if alternatives are used;
(e) Losses per kilogram of methyl bromide requested if alternatives are used;
(f) Losses as a percentage of net cash revenue if alternatives are used;
(g) Percentage change in profit margin if alternatives are used.

For this analysis, net revenue is calculated as gross revenue minus operating costs. This is a good measure of the direct losses of income that may be suffered by the users. 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 often difficult to measure and verify.

TABLE E 1 SOUTHEASTERN STATES - 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$)	$ 0.20	$ 0.20	$ 0.20
= 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%

TABLE E 2. CALIFORNIA - 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)	796	696	716
* PRICE PER UNIT (US$)	$ 60.00	$ 60.00	$ 60.00
= GROSS REVENUE PER HECTARE (US$)	$ 47,741	$ 41,773	$ 42,967
- OPERATING COSTS PER HECTARE (US$)	$ 37,831	$ 40,157	$ 37,664
= NET REVENUE PER HECTARE (US$)	$ 9,909	$ 1,616	$ 5,303
LOSS MEASURES			
1. LOSS PER HECTARE (US$)	$0	$ 8,293	$ 4,606
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$ 31.49	$ 17.49
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	17%	10%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	84%	46%

The economic assessment of feasibility for pre-plant uses of methyl bromide included an evaluation of economic losses from three basic sources: (1) yield losses, referring to reductions in the quantity produced, (2) quality losses, which generally affect the price received for the goods, and (3) 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.

The economic reviewers then 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) Losses as a percent of gross revenues. 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.

(2) Absolute losses 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.

(3) Losses per kilogram of methyl bromide requested. This measure indicates the value of methyl bromide to crop production but is also useful for structural and post-harvest uses.

(4) Losses as a percent of net revenues. We define net 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.

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.

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 changes in yield. The loss expressed as a percentage of the gross revenue is based on the ratio of the loss to the gross revenue using methyl bromide. Likewise for the loss as a percentage of net revenue. These losses are shown in Tables E.1 and E.2.

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 two fumigation scenarios in the Southeastern States: 1) metam sodium; and 2) 1,3-D + chloropicrin.

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

The major production issue facing nursery growers is that customers of nursery stock require pest-free transplants. If there are incidences of disease, weeds, or insect infestation, nursery 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. A small infestation of nursery stock will be multiplied many times as plants are placed in fields for fruit production. Nearly a billion plants are produced by California strawberry nurseries each year, with world-wide distribution. There are approximately 13 seedling/runner producers in California that must manage disease incidence over the 4-year production cycle of the strawberry stock.

<u>Part F:</u> NATIONAL MANAGEMENT STRATEGY FOR PHASE-OUT OF THIS NOMINATED CRITICAL USE
<u>Renomination Form Part B:</u> TRANSITION PLANS

Provision of a National Management Strategy for Phase-out of Methyl Bromide is a requirement under Decision Ex. I/4(3) for nominations after 2005. The time schedule for this Plan is different than for CUNs. Parties may wish to submit Section 21 separately to the nomination.

21. DESCRIBE MANAGEMENT STRATEGIES THAT ARE IN PLACE OR PROPOSED TO PHASE OUT THE USE OF METHYL BROMIDE FOR THE NOMINATED CRITICAL USE, INCLUDING:

1. *Measures to avoid any increase in methyl bromide consumption except for unforeseen circumstances;*
2. *Measures to encourage the use of alternatives through the use of expedited procedures, where possible, to develop, register and deploy technically and economically feasible alternatives;*
3. *Provision of information on the potential market penetration of newly deployed alternatives and alternatives which may be used in the near future, to bring forward the time when it is estimated that methyl bromide consumption for the nominated use can be reduced and/or ultimately eliminated;*
4. *Promotion of the implementation of measures which ensure that any emissions of methyl bromide are minimized;*
5. *Actions to show how the management strategy will be implemented to promote the phase-out of uses of methyl bromide as soon as technically and economically feasible alternatives are available, in particular describing the steps which the Party is taking in regard to subparagraph (b) (iii) of paragraph 1 of Decision IX/6 in respect of research programmes in non-Article 5 Parties and the adoption of alternatives by Article 5 Parties.*

These issues are discussed in the US Management Plan for Methyl Bromide, submitted previously.

Renomination Form Part C: TRANSITION ACTIONS

Responses should be consistent with information set out in the applicant's previously-approved nominations regarding their transition plans, and provide an update of progress in the implementation of those plans.

In developing recommendations on exemption nominations submitted in 2003 and 2004, the Technology and Economic Assessment Panel in some cases recommended that a Party should explore the use of particular alternatives not identified in a nomination' transition plans. Where the Party has subsequently taken steps to explore use of those alternatives, information should also be provided in this section on those steps taken.

Questions 5 - 9 should be completed where applicable to the nomination. Where a question is not applicable to the nomination, write "N/A".

(Renomination Form 6.) TRIALS OF ALTERNATIVES
Where available, attach copies of trial reports. Where possible, trials should be comparative, showing performance of alternative(s) against a methyl bromide-based standard.

See Section 15 above for selected trial results and citations.

(i) DESCRIPTION AND IMPLEMENTATION STATUS:

These issues are discussed in the US Management Plan for Methyl Bromide, submitted previously.

(ii) OUTCOMES OF TRIALS: (*Include any available data on outcomes from trials that are still underway. Where applicable, complete the table included at Appendix I identifying comparative disease ratings and yields with the use of methyl bromide formulations and alternatives.*)

See Section 15 above for selected trial results and citations.

(iii) IMPACT ON CRITICAL USE NOMINATION/REQUIRED QUANTITIES: *(For example, provide advice on any reductions to the required quantity resulting from successful results of trials.)*

During the preparation of this nomination the USG has accounted for all identifiable means to reduce the request. Specifically, approximately 15 million kilograms of methyl bromide were requested by methyl bromide users across all sectors. USG carefully scrutinized requests and made subtractions to ensure that no growth, double counting, inappropriate use rates on a treated hectare basis was incorporated into the final request. Use when the requestor qualified under some other provision (QPS, for example) was also removed and appropriate transition given yields obtained by alternatives and the associated cost differentials were factored in. As a result of all these changes, the USG is requesting roughly 1/3 of that amount.

The USG feels that no additional reduction in methyl bromide quantities is necessary, given the significant adjustments described above. See Appendix A.

(iv) ACTIONS TO ADDRESS ANY DELAYS/OBSTACLES IN CONDUCTING OR FINALISING TRIALS:

The USG has the ability to authorize Experimental Use Permits (EUPs) for large scale field trials for methyl bromide alternatives, as has been done for methyl iodide. A recent change has been to allow the EUP for methyl iodide without the previously required destruction of the crop, thus encouraging more growers to participate in field trials. As with other activities connected with registration of a pesticide, the USG has no legal authority either to compel a registrant to seek an EUP or to require growers to participate.

As noted in our previous nomination, the USG provides a great deal of funding and other support for agricultural research, and in particular, for research into alternatives for methyl bromide. This support takes the form of direct research conducted by the Agricultural Research Service (ARS) of USDA, through grants by ARS and CSREES, by IR-4, the national USDA-funded project that facilitates research needed to support registration of pesticides for specialty crop vegetables, fruits and ornamentals, through funding of conferences such as MBAO, and through the land grant university system.

(Renomination Form 7.) TECHNOLOGY TRANSFER, SCALE-UP, REGULATORY APPROVAL FOR ALTERNATIVES

The USDA maintains an extensive technology transfer system, the Agricultural Extension Service. This Service is comprised of researchers at land grant universities and county extension agents in addition to private pest management consultants. In addition to these sources of assistance for technology transfer, there are trade organizations and grower groups, some of which are purely voluntary but most with some element of institutional compulsion, that exist to conduct research, provide marketing assistance, and to disseminate “best practices”. The California Strawberry Commission is one example of such a grower group.

(i) DESCRIPTION AND IMPLEMENTATION STATUS:

See above.

(ii) OUTCOMES ACHIEVED TO DATE FROM TECHNOLOGY TRANSFER, SCALE-UP, REGULATORY APPROVAL:

See Section 21.

(iii) IMPACT ON CRITICAL USE NOMINATION/REQUIRED QUANTITIES: (*For example, provide advice on any reductions to the required quantity resulting from successful progress in technology transfer, scale-up, and/or regulatory approval.*)

The USG feels that no additional change in methyl bromide quantity requested is necessary. The U.S. nomination for this sector reflects the commitment by this sector and the U.S. to reduce methyl bromide use to only the most critical needs. See Appendix A.

(iv) ACTIONS TO ADDRESS ANY DELAYS/OBSTACLES:

See above.

Ongoing field trials require results to be validated for commercial application. Therefore, some period of time after publication of field trials is needed for commercial testing and implementation.

USG endeavors to identify methyl bromide alternatives to move them forward in the registration queue. However USG has no legal authority to compel registrations; it can only act on registrations requested by private entities. The timely submission of data to support a registration decision is at the sole discretion of the registrant.

(Renomination Form 8.) COMMERCIAL SCALE-UP/DEPLOYMENT, MARKET PENETRATION OF ALTERNATIVES

(i) DESCRIPTION AND IMPLEMENTATION STATUS:

These issues are discussed in the US Management Plan for Methyl Bromide, submitted previously.

(ii) IMPACT ON CRITICAL USE NOMINATION/REQUIRED QUANTITIES: (*For example, provide advice on any reductions to the required quantity resulting from successful commercial scale-up/deployment and/or market penetration*.)

The USG feels that no additional change in methyl bromide quantity requested is necessary. The U.S. nomination for this sector reflects the commitment by this sector and the U.S. to reduce methyl bromide use to only the most critical needs. See Appendix A.

(iii) ACTIONS TO ADDRESS ANY DELAYS/OBSTACLES:

USG endeavors to identify methyl bromide alternatives to move them forward in the registration queue. However USG has no legal authority to compel registrations; it can only act on registrations requested by private entities. The timely submission of data to support a registration decision is at the sole discretion of the registrant.

The USDA maintains an extensive technology transfer system, the Agricultural Extension Service. This Service is comprised of researchers at land grant universities and county extension agents in addition to private pest management consultants. In addition to these sources of assistance for technology transfer, there are trade organizations and grower groups, some of which are purely voluntary but most with some element of institutional compulsion, that exist to conduct research, provide marketing assistance, and to disseminate "best practices". The California Strawberry Commission is one example of such a grower group.

(Renomination Form 9.) CHANGES TO TRANSITION PROGRAM
If the transition program outlined in the Party's original nomination has been changed, provide information on the nature of those changes and the reasons for them. Where the changes are significant, attach a full description of the revised transition program.

See Appendix A.

(Renomination Form 10.) OTHER BROADER TRANSITION ACTIVITIES
Provide information in this section on any other transitional activities that are not addressed elsewhere. This section provides a nominating Party with the opportunity to report, where applicable, on any additional activities which it may have undertaken to encourage a transition, but need not be restricted to the circumstances and activities of the individual nomination. Without prescribing specific activities that a nominating Party should address, and noting that individual Parties are best placed to identify the most appropriate approach to achieve a swift transition in their own circumstances, such activities could include market incentives, financial support to exemption holders, labelling, product prohibitions, public awareness and information campaigns, etc.

These issues are discussed in the US Management Plan for Methyl Bromide, submitted previously.

Part G: CITATIONS

CDFA (California Department of Food and Agriculture). 2003. Summary of California Laws and Regulations Pertaining to Nursery Stock. http://www.cdfa.ca.gov/phpps/pe/nipm.htm

Kabir, Z., Fennimore, S., Martin, F., Ajwa, H., Duniway, J., Browne, G., Winterbottom, C., Westerdahl, B., Goodhue, R., Guerrero, L., and Haar, M. 2003. Alternative[s] Fumigants for the Control of Soil Pests: Strawberry as a Model System. Methyl Bromide Alternatives Conference (2003). www.mbao.org.

Kabir, Z., Fennimore, S. A., Duniway, J. M., Martin, F. N., Browne, G. T., Winterbottom, C. Q., Ajwa, H. A., Westerdahl, B. B., Goodhue, R. E., and Haar, M. J. 2005. Alternatives to methyl bromide for strawberry runner plant production. HortScience 40(6):1709-1715.

Larson, K. D., D.V. Shaw. 2000. Soil Fumigation and Runner Plant Production: A Synthesis of 4 Yrs of Strawberry Nursery Field Trials. HortSci 35(4):642-646.

Noling, J. W. 2006. Resolving restricted export of strawberry plants from Quebec to Florida due to the Golden Nematode. University of Florida Extension Service Berry/Vegetable Times (newsletter) Sept/Oct 2006. http://strawberry.ifas.ufl.edu/BerryTimes/BVTSept-Oct06.html

NCDA (North Carolina Department of Agriculture and Consumer Services), undated. Nursery Regulations, Nursery Certification. http://www.ncagr.com/plantind/Regs/48a1200.htm, http://reports.oah.state.nc.us/ncac/title%2002%20-%20agriculture%20and%20consumer%20services/chapter%2048%20-%20plant%20industry/subchapter%20a/02%20ncac%2048a%20.1210.html

APPENDIX A. 2009 METHYL BROMIDE USAGE NEWER NUMERICAL INDEX EXTRACTED (BUNNIE)

2009 Methyl Bromide Usage Newer Numerical Index - BUNNIE					Strawberry Nursery	
December 18, 2006	Region		CA Strawberry Nursery Assoc.	SE Strawberry Consortium	Sector Total or Average	Notes
Dichotomous Variables	Strip or Bed Treatment?		No	Strip		
	Currently Use Alternatives?		Yes	Yes		
	Tarps / Deep Injection Used?		Tarp	Tarp		
	Pest-free Cert Requirements?		Yes	Yes		
Other Issues	Frequency of Treatment (x/ yr)		1x/ year	1x/ year		*
	QPS Removed?		Yes	Yes		
Most Likely Combined Impacts (%)	Florida Telone Restrictions (%)		0%	0%		
	100 ft Buffer Zones (%)		0%	0%		
	Key Pest Distribution (%)		100%	100%		
	Regulatory Issues (%)		11%	0%		
	Unsuitable Terrain (%)		0%	0%		
	Cold Soil Temperature (%)		0%	0%		
	Total Combined Impacts (%)		**100%**	**100%**		
Most Likely Baseline Transition	(%) Able to Transition		0%	0%		
	Minimum # of Years Required		0	0		
	(%) Able to Transition / Year		**0%**	**0%**		
EPA Adjusted Use Rate (kg/ha)			**263**	**350**		
EPA Adjusted Strip Dosage Rate (g/m2)			26.3	35.0		
2009 Requested Usage	*Amount - Pounds*	*Pounds*	*10,340*	*77,017*	*87,357*	
	Area - Acres		*44*	*209*	*253*	
	Rate (lb/A)		*235.00*	*368.50*	*345*	
	Amount - Kilograms	Metric	**4,690**	**34,934**	**39,624**	
	Treated Area - Hectares		18	72	90	
	Rate (kg/ha)		263	484	440	
EPA Preliminary Value		**kgs**	**4,690**	**39,624**	**44,314**	
EPA Baseline Adjusted Value has been adjusted for:			MBTOC Adjustments, QPS, Double Counting, Growth, Use Rate/Strip Treatment, Miscellaneous, and Combined Impacts			
EPA Baseline Adjusted Value		kgs	4,690	3,693	8,383	
EPA Transition Amount		kgs	-	-	-	
EPA Amount of All Adjustments		kgs	**-**	**(35,931)**	**(35,931)**	
Most Likely Impact Value for Treated Area		kgs	**4,690**	**3,693**	**8,383**	
		ha	**18**	**11**	**28**	
		Rate	**263**	**350**	**296**	
Sector Research Amount (kgs)			**454**	**2009 Total US Sector Nomination**	**8,837**	

APPENDIX B. EXCERPTS OF THE CALIFORNIA STRAWBERRY NURSERY NARRATIVE

Excerpts of the California Strawberry Nursery Narrative (submitted by the California Strawberry Commission, in 2005)

Introduction

The strawberry plant nursery stock produced annually in California represents one of the largest and most widely distributed nursery products in the world. Nearly a billion plants are produced by the California strawberry nursery system each year, and plants are annually distributed from California to every continent with a temperate climate suitable for strawberry fruit production. In addition, many nursery systems in other parts of the United States and throughout the world rely on California strawberry stock as a source for their propagation systems. The integrity of California strawberry nursery systems directly influences the global success of strawberry fruit as a viable crop.

Description of Strawberry Nursery Production System

Due to the complex genetic structure of the modern strawberry, plants do not replicate true to type from seed, and must be asexually propagated by rooting runners produced from source plants. The California strawberry nursery industry is responsible for providing genetically pure and clean planting material essential to the success of strawberry fruit growers and other nursery systems. Strawberry nurseries annually plant source stocks in fumigated fields, root the runners that form, and harvest these runner plants as a final product.

The strawberry nursery industry is a very complex system. A typical nursery system includes both high and low elevation nursery locations, chosen to provide a cold site for October harvest which provides fresh plants for fruit production systems, and a warmer site for December - January harvest which provides frigo plants for nursery stock and frigo plants for fruit production systems.

The high elevation nurseries are located in Northern California and Southern Oregon at elevations of 3,200 to 4,200 feet, and produce the plants used for October and November plantings for fruit production in California, throughout the United States, and internationally.

Low elevation nurseries (below 600 feet) are located in the Sacramento and northern San Joaquin valleys of California. These low elevation nurseries produce plants for both propagation and fruit plantings. The propagation stock is used by nurseries in California, throughout the United States, and internationally. The balance of the low elevation production is stored for distribution through the spring and summer months as frigo plants, and supplies fruit production systems throughout the world.

The nursery stock regulations include fumigation standards, as well as standards for virus, pathogen and insect control.

Year 1 Plants are grown in a screenhouse as nuclear stock. The source plants have been heat treated and meristemed in order to insure a virus and disease free stock for this first cycle of nursery production. Nurserymen may heat treatment and meristem stock in their own facilities, or may purchase meristem stock plants from the Foundation Plant Material Services located at the University of California, Davis, California.

Year 2 Meristemed stock is planted in an enclosed screenhouse structure, designed to exclude insect vectors preventing plant contamination. These plants are planted into fumigated soil or media. The plants produce about 100 daughter plants per mother plant. CDFA inspectors examine and laboratory-test screenhouse stocks to insure that the plants are virus and nematode free. They closely inspect for other possible insect and disease pressures. There is no tolerance for virus, nematodes, and plant diseases in screenhouse propagation. The screenhouses are generally located in low elevation nursery sites.

Year 3 Plant increases harvested from screenhouses are planted in low elevation nursery fields. The increase ratio at this level is about 50:1. These low elevation fields are called Foundation increases, and are planted outside in carefully fumigated soils. The CDFA samples these fields for nematodes and virus intrusion, and inspects carefully for full control of insect and disease levels. There is no tolerance for nematodes and virus in foundation plantings.

Year 4 Plants from the Foundation are planted into low elevation fields that have been fumigated. Fields at this level are referred to as Registered increases. The increase ratio at this level is about 50:1. These fields are inspected by the CDFA and are sampled for nematode infection. Diseases and insects are also carefully monitored at this level. There is a zero tolerance for nematodes and virus symptoms at this level. These plants are often sold worldwide as propagative stocks to nursery systems and to fruiting systems with critical needs for pathogen control.

Year 5 Plants from the Registered Fields are planted into high and low elevation fields that have been fumigated. Propagation at this level can be registered as Certified Field increases. Plants in certified fields are increased at a level of about 30:1. The CDFA inspections make sure that the fields are clean of nematode and virus infections, and evaluate insect and disease pressures for phytosanitary clearances. These plants are sold and planted for fruit production both domestically and internationally.

About 70% of the ground used for strawberry nursery production is owned by the nursery grower, and the other 30% is leased. Nurseries need sandy loam soils to allow for the deep rooting pattern produced by strawberry plants. Strawberry roots may grow three feet or more into the soil during a growing season and therefore the fumigant used for nursery production needs to be able to penetrate deeply into the soil. There are a few heavier soils used in the strawberry nursery industry which are more difficult to manage.

The total high elevation nursery acreage averages 3,200 acres per year, and the low elevation acreage averages 1,000 acres per year. The locations where strawberry nurseries are grown are dry and hot in the summer months and cold in the winter months. Rainfall averages about 20 inches per year in the high elevation locations and 30 inches per year in the low elevation locations.

Strawberry nursery fields are planted in the spring, and may be fumigated in the previous fall (August and September) on fallow ground, or may be fumigated in the spring (March and April) prior to planting. The majority of the fumigation is done in the fall (60%), but the spring fumigation is a very important option to provide the flexibility to adjust acreage based on a later projected demand. While some of the nursery growers fumigate their own fields, about 65% of the growers have contract fumigators apply the material.

Strawberry nursery culture is labor intensive. Nurseries maintain a sizeable permanent staff, and hire thousands of workers on a seasonal basis.

Nursery fields are spring planted using crews on four row mechanical transplanters. In high elevation nurseries, about 12,000 plants are placed per acre, and low elevation fields with longer growing seasons are planted with about 6,000 plants per acre.   As the plants grow, runners are produced and are set by hand. Field weeds that survive fumigation are also removed by hand. This is an important part of the viral disease prevention program as some of the weeds found in nursery areas harbor virus that can be transmitted to strawberry plants. During the season, the runners produced form a solid canopy of leaf cover over the field. Before the plant canopy fills in, tractors can be used in the field to spray if necessary. Overhead sprinkler irrigation systems are used to irrigate, as well as to fertigate the fields as necessary. As the canopy fills in, tractors are no longer able to drive through the field, and chemicals are also be applied through the overhead sprinkler system when necessary. A few nurseries are now using drip irrigation instead of the standard sprinkler irrigation.

High elevation fields are harvested starting in late September when the temperatures begin to fall and the strawberry plants begin to go dormant. High elevation harvests continue through late October at which time the plants should be fully dormant. Low elevation plants are harvested in December or January after the plants are fully dormant. Several pieces of equipment are used during the harvest process. The strawberry plant leaves are removed with a mulching mower, and interconnecting runners are broken apart with a mechanical rake. The strawberry harvester is a custom designed machine that undercuts the plants, lifts the plants from the soil, and shakes remaining soil free from the root system. Plants are placed in burlap bags or bin containers on the back of the harvesters, and are loaded for transport.

During this process, about 50% of the crop biomass is left in the field. This remaining biomass consists mainly of leaf tissue, root tissue, and crowns of smaller plants. Several nurseries are now leaving the original mother plants in the field as well as the leaf tissue which further reduces the amount of biomass removed from the field. This remaining biomass is plowed back into the field before the field during the rotation cycle.

Harvested plants are removed from the field, placed in pre-cooled trucks and transported promptly from the field to the trim shed. At the trim shed, the plants are held briefly in cold storage and then trimmed and graded by large processing crews. This stage requires a large amount of skilled and qualified labor to achieve reasonable production output rates and a high quality product.

The hand-trimmed plants are graded for quality based on crown size and root development, and are packed into boxes containing 1,000 to 1,500 plants. Only plants that meet the quality grade standards are packed, and the other plants are discarded. The packed boxes are placed back into cold storage (28 - 32 degrees F) for final cooling, and are shipped on pre-cooled trucks, refrigerated ocean containers, or by fast air shipments to customers worldwide.

Nursery fields are rotated out of strawberries and into cover crops for an average of two years between strawberry planting cycles. The cover crops used are generally grains, and may be harvested, but are primarily used to increase the organic matter in the soil. Other cover crops include endive, garlic, onions, horseradish, and mint.

Fumigation and Pathogen, Nematode and Weed Control in Strawberry Nurseries

Methyl Bromide/Chloropicrin fumigation currently used at the strawberry nursery controls soil borne pathogens, nematodes, and weeds. Deep, uniform fumigation is necessary to provide the nursery with a strong base for producing clean planting stock. Methyl bromide is an ideal fumigant due to the small molecular size of the gas, which allows the fumigant to move easily through the soil and penetrate deeply into the soil profile.

The combination of Methyl Bromide and Chloropicrin thoroughly and completely sterilizes the soil from the surface to beyond the penetrable depth of the nursery crop root system. There are over 60 identified fungal diseases and seven major nematode groups that infect strawberry, and the Methyl Bromide/Chloropicrin combination is highly effective against all of them. There are many weed types common to strawberry nursery growing areas, and Methyl Bromide is by far the most effective soil treatment to eliminate them in nursery plantings. Some of the most important nematode, disease, and weed pests are listed and discussed below.

The major soil born diseases that are a problem in strawberries and are controlled by methyl bromide at the nursery level are shown in Table 1. Methyl Bromide readily kills pathogens in plant debris left in the field after harvest as well as common soil borne diseases.

Table 1. Major problem diseases in Strawberry Nursery Production

Disease	**Causal Organism**
Red Stele	*Phytophthora fragariae*
Crown Rot	*Phytophthora cactorum*
Root Rot	*Phytophthora citricola*
Anthracnose	*Colletotrichum acutatum*
Verticillium wilt	*Verticillium dahliae*
Powdery Mildew	*Sphaerotheca macularis*
Angular Leaf Spot	*Xanthomonas fragariae*
Common Leaf Spot	*Ramularia tulasneii*
Black Root Rot	*Pythium, Rhizoctonia, Cylindrocarpon*

Fumigation is also used to control nematodes (Table 2). Because fumigation is used in strawberry nurseries, nematodes have not been a problem in nurseries or production fields since the 1960's when Methyl Bromide fumigations were first used. The effectiveness of Methyl Bromide/Chloropicrin mixture in controlling nematodes contributed to the adoption of the California Nursery Stock Regulations. These regulations do not permit nursery stock infested with nematodes to be shipped from the nursery. All certified nursery plantings are sampled parasitic nematodes, and if any are found, the infected area is rejected for harvest.

Table 2. Nematodes controlled in Strawberry Nursery Production

Common Name	**Scientific Name**
Root Knot Nematode	*Meloidogyne hapla*
Sting Nematode	*Belonolaimus longicaudatus*
Dagger Nematode	*Xiphinema americanum*
Stem Nematode	*Ditylenchus dipsaci*
Root Lesion Nematode	*Pratylenchus penetrans*

Needle Nematode	*Longidorus elongatus*
Foliar Nematode	*Aphelenchoides ritzemabosi*

Fumigation is also used to control weeds (Table 3) found in California strawberry nurseries. Several of the weeds types in California strawberry nurseries areas are classified as noxious weeds by the state of California. It is important to use a fumigant that can effectively control weeds to prevent spread of seed adhering to soil particles on plants that are shipped both domestically and internationally by strawberry nursery growers. Weeds are also hosts for viruses that can be spread to strawberry plants by vectors present at the nursery.

An additional benefit is the complete control of strawberry seed from previous plantings that might germinate in a nursery field. If strawberry seed germinates in a nursery planting, variety mixes are created rendering the planting unsaleable.

Table 3. Common weeds present in Strawberry Nurseries

Common Name	**Scientific Name**
Annual bluegrass	*Poa annua*
Bur clover	*Medicago hispida*
Carpetweed	*Mollugo verticillata*
Chickweed	*Stellaria media*
Field bindweed	*Convolvulus arvensis* *
Filaree	*Erodium botrys*
Goat Grass	*Aegilops triuncialis*
Hairy Nightshade	*Solanun villosum**
Lambsquarter	*Chenopodium album*
Malva	*Malva parviflora*
Nutsedge	*Cyperus rotundus**
Pig Weed	*Amaranthus retroflexus*
Portulaca	*Oleracae*
Prostrate Spurge	*Euphorbia humistrata*
Puncture vine	*Tribulus terrestris**
Purslane	*Portulaca oleracea*
Vetch	*Vicia sativa*

*Considered noxious weeds by the California Department of Food and Agriculture.

Methyl Bromide and Strawberry Nursery Culture

The challenges in strawberry nursery production are considerable. All customers for strawberry stock depend on the nurseries to provide stock free of pests and pathogens for planting. Since the nurseries have the plants for multiple production cycles before the plants are sent to the fruit growers and nursery customers, any tiny problem or minute infection that occurs in the nursery system can be multiplied many times, and over several years before the plants are sold (Table 4).

Table 4. Amplification Schedule for Short Day and Day Neutral Cultivars

		Approx. amplification numbers	
Year	**Nursery Locations**	**Short Day Cultivars**	**Day Neutral Cultivars**
0	Low Elevation - Meristem Plant	1	1
1	Low Elevation - Screenhouse	100	100
2	Low Elevation - Foundation Field	50	35
3	Low Elevation - Registered Field	50	35

4	High Elevation - Certified Field	25	20
	Total Increase Ratio	**6,250,000**	**2,450,000**

The challenge in growing clean strawberry nursery stock is easy to visualize from Table 4. From the usual four-year process, a single plant placed in a screenhouse increase on year 1 can be increased to as many as six million plants by the end of year 4. The tiniest contamination level in years 1 and 2 can have a very broad effect on the general cleanliness status of the nursery in years three and four. Even if diseases did not spread to other plants in a field, an infection on year one could yield six million infected plants by harvest in year 4. Unfortunately, spread rates in field conditions for fungal diseases are very high, and any minute disease intrusion in propagation years 1 and 2 will lead to a general infection in production stock. Because of rapid spread rates, even minute disease intrusion into propagation in year 3 will introduce considerable disease exposure in propagation in year 4.

The challenge is even larger when the disease organisms affecting strawberry are considered. In referring to table 4, most of the fungal diseases affecting strawberry are capable of multiplying as many times per day as we might expect to multiply in plant numbers for the year. The diseases can be asymptomatic on the strawberry plants and therefore very difficult or impossible to detect until environmental conditions are conducive for disease development. Most of the nematode pests can multiple themselves weekly by what could be multiplied annually in plants numbers.

The challenge is thus defined. A strawberry nursery must increase stock in the system over a four year period, and end the process with uncontaminated stock. To do this, a strawberry nursery must do more than manage disease pressure. To be successful, the strawberry nursery must very effectively manage disease incidence. Apparent plant health and acceptable disease thresholds are not part of the language of successful strawberry nursery culture. A strawberry nursery is successful only if major plant disease incidences are controlled. The success of the nursery product provided to customers is directly related to the nursery's ability to exert this control.

As mentioned, the California strawberry nurseries produce around one billion plants annually, and production distribution is worldwide. In addition, propagation in strawberry in many countries depends on California produced nursery stocks. Canadian and Mexican nurseries use almost 80 percent California source stocks, and a high percentage (40-60%) of Spanish and South American propagation is also based on California sources. Most strawberry systems in the world are using some stocks with origin from California nurseries.

Because the strawberry plants from California are so widely distributed, any disease and insect problems that are not controlled by the California nurseries will become international control and quarantine issues.

The strawberry nursery use is possibly the most critical of the applications that will be considered in the Critical Use Exemption process. In any test evaluation that considers the spectrum of disease control important to strawberry, every chemical and every combination and every alternative scheme has proved inferior to the broad efficacy of Methyl Bromide Fumigation. There has been no data produced that would suggest alternative soil fumigation regimes provide the short and long term disease control integrity required.