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 _PEPPERS GROWN IN OPEN FIELDS__

BRIEF DESCRIPTIVE TITLE OF NOMINATION:
Methyl Bromide Critical Use Nomination for Preplant Soil Use for Peppers Grown in Open Fields (Submitted in 2007 for 2009 Use Season)

CROP NAME (OPEN FIELD OR PROTECTED):
Peppers Grown in Open Field

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	**783.821**

*This amount includes methyl bromide needed for research.

SUMMARY OF ANY SIGNIFICANT CHANGES SINCE SUBMISSION OF PREVIOUS NOMINATIONS:

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. California pepper growers have also been added to this nomination based on new yield loss information they have submitted. USG also refined the estimates of the proportion of crop acreage to which methyl bromide alternatives involving 1,3 D + chloropicrin could not be used due to Karst and seepage irrigation restrictions. For details on these changes in usage requirements, please see Appendix B.

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

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

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in pepper production.
- Geographic distribution of key target pests: i.e., some alternatives may be comparable to methyl bromide as long as key pests occur at low pressure, and in such cases the U.S. is only nominating a CUE for peppers where the key pest pressure is moderate to high such as nutsedge in the Southeastern U.S.
- Regulatory constraints: e.g., 1,3 D use is limited in Georgia and Florida due to the presence of karst topography.
- Potential delay in planting and harvesting: e.g., the plant-back interval for 1,3 D + Chloropicrin may be up to two weeks longer than methyl bromide + chloropicrin. In Michigan an additional delay would occur because soil temperature must be higher to fumigate with alternatives. Delays in planting and harvesting may result in users missing key market windows, and adversely affect revenues through lower prices.

Michigan, Florida, Georgia, and the Southeastern U.S. (except Georgia and Florida) are each presented as separate regions in this nomination to reflect the separate applications from growers in these areas. A brief description of their need for methyl bromide follows, also presented on a regional basis.

Michigan

The key pest of peppers in Michigan is the soil fungus *Phytophthora capsici*, which can easily destroy the entire harvest from affected areas if left uncontrolled. While 1,3-D + chloropicrin provided some control in small plot trials with peppers and other vegetable crops in Michigan (Hausbeck and Cortright 2003), the level of control was lower than that afforded by methyl bromide. *P. capsici* has recently been shown to also occur in irrigation water in Michigan (Gevens and Hausbeck 2003). This will increase the likelihood of spread of this pathogen. It is also not yet clear whether these small-scale research results accurately reflect efficacy of methyl bromide alternatives in pepper production. Furthermore, regulatory restrictions due to concerns over human exposure and ground water contamination, along with technical limitations, can make 1,3-D + chloropicrin economically infeasible as a methyl bromidealternative. Among the more important regulatory restrictions is a potential delay in planting as long as 28 days, (which could lead to missing a key market window) due to label restrictions and low soil temperatures, and a mandatory 30 meter buffer for treated fields near inhabited structures.

Based on the small-plot trial conducted on Michigan peppers (cited above), the best-case yield loss estimate for Michigan using the best available methyl bromide alternative (1,3-D + chloropicrin) was estimated to be 6 %, based on plant loss. In a second trial undertaken by Hausbeck and Cortright (2004), yields from pepper plots treated with metam potassium, alone or in combination with chloropicrin, and from plots treated with 1,3-D + chloropicrin were comparable to yields from plots treated with methyl bromide + chloropicrin and yields from untreated (control plots). These results likely indicate a very low pest pressure in all treated and control plots. It is also unfortunate that these trials occurred later in the growing season (June) than in the early season (April), to which this nomination pertains.

Michigan pepper farmers requesting methyl bromide must plant by the first week of May to capture an early market window. This market window provides a premium crop price that remains critical for growers' economic feasibility. Soil fumigation must therefore be completed by mid April to allow 14-21 days for aeration. However, 1,3-D and metam labels recommend that applications be made when soil temperatures (at application depth) are above 4.4°C. Furthermore, optimum soil temperatures for 1,3-D are in the 10°C - 25°C range (University of California, Davis, undated). Since soil temperatures in Michigan do not climb over 10°C until after mid to late May (Schaetzl and Tomczak, 2001), neither 1,3-D nor metam products can be used effectively for early pepper planting in Michigan. Metam products have the additional disadvantage that when the soil is wet and cold (below 15°C), the minimum recommended plant back period is 30 days, which would push the crop beyond the early market window.

Southeastern United States (Including Florida and Georgia)

In the Southeastern United States, including Florida and Georgia, methyl bromide is requested primarily for control of moderate to severe infestations of nutsedge weeds. *P. capsici* is also an important pest targeted currently with methyl bromide in these regions. Many growers also use methyl bromide against root-knot nematodes. Left uncontrolled, any of these pests could completely destroy the harvests from affected areas.

Of currently available methyl bromide alternatives, metam-sodium offers inconsistent control of nutsedges and nematodes, while 1,3-D + chloropicrin provides adequate control of nematodes and disease (Locascio et al. 1997, Eger 2000, Noling et al. 2000). However, metam-sodium has yield losses of up to 44 % compared to methyl bromide where weed infestations are moderate to severe (Locascio et al. 1997). Metam-sodium also creates a planting delay as long as 30 days to avoid risk of phytotoxic injury to crops compared to a 14-day delay for methyl bromide. Furthermore, due to regulatory restrictions resulting from groundwater contamination concerns, 1,3-D + chloropicrin cannot be used in large portions of the southeastern United States due to the presence of karst topographic features, and anywhere in Dade County, Florida, where the majority of that region's peppers are grown. There is also a 28 day planting delay due to regulatory restrictions for 1,3-D + chloropicrin. In Florida particularly, growers are on a tight production schedule and must place pepper transplants in fields at a certain time of the year (see Table 11.2 in the Florida section for details). Relying only on metam sodium for preplant treatment would force growers to fumigate earlier in their season, which in turn would extend the fumigation schedule into rainy periods. Growers would have to fumigate earlier to avoid rain and lose a portion of the crop (Aerts, 2004).

Furthermore, trials of metam-sodium and 1,3 D + chloropicrin (and various combinations thereof) are based on small plot research trials conducted in the Southeastern United States on crops other than peppers. For fungi and nutsedge, no on-farm, large-scale trials have yet been done. Some researchers have also reported that these methyl bromide alternatives degrade more rapidly in areas where they are applied repeatedly due to enhanced metabolism by soil microbes (Dungan and Yates 2003, Gamliel et al. 2003). This may compromise long-term efficacy of these compounds and appears to need further scientific scrutiny.

In a recent field study conducted in Tifton, Georgia by Culpepper and Langston (2004), 1,3-D +

chloropicrin, followed by more chloropicrin, was more effective than methyl bromide against yellow nutsedge, but less effective against purple nutsedge. Although this treatment performed as well as methyl bromide in terms of spring pepper yield, its fall yield performance was inferior to that of methyl bromide.

In a second treatment, 1,3-D by itself, followed by chloropicrin, was significantly less effective than methyl bromide for the control of both purple and yellow nutsedge, but as effective as methyl bromide for the control soil nematodes. In terms of spring and fall pepper yield, however, this treatment performed as well as methyl bromide.

In a third treatment, 1,3-D + chloropicrin, followed by metam sodium, was as effective as methyl bromide against yellow nutsedge, 36% less effective than methyl bromide against purple nutsedge, and as effective as methyl bromide for the control of soil nematodes. This treatment also performed as well as methyl bromide in terms of both spring and fall pepper yield.

Although these combinations are showing promise, they will require further testing and validation.

California

In California methyl bromide is requested primarily for the control of *Phytophthora capsici*. Research work sponsored by the California Pepper Commission has demonstrated that the isolates of Phythophthora are resistant to the available fungicides, there are no commercially available resistant varieties, and that the alternative fumigants cannot provide season long control.

In sum, although promising, these methyl bromide alternatives require further testing and validation at the commercial level before being available for adoption by pepper growers. Therefore, methyl bromide remains a critical use for peppers in the United States.

(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.

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Following the requirements of Decision IX/6 paragraph (a)(1) The United States of America has determined that the specific use detailed in this Critical Use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption. ☐ Yes ☐ No

____________________________ ______________________________ _______________

Signature Name Date

Title: ____

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

1. PAPER DOCUMENTS: **Title of paper documents and appendices**	**No. of pages**	**Date sent to Ozone Secretariat**
USA CUN09 SOIL __PEPPERS___ 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 __PEPPERS___ 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 Peppers Open Field

2. (Renomination Form 2.) DESCRIPTIVE TITLE OF NOMINATION:

Methyl Bromide Critical Use Nomination for Preplant Soil Use for Peppers Grown in Open Fields (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)*):

Peppers grown in Alabama, Arkansas, California, Florida, Georgia, Kentucky, Louisiana, Michigan, North Carolina, South Carolina, Tennessee, and Virginia. These crops are grown in open fields on plastic tarps, often followed by various other crops. Harvest is destined for the fresh market**.**

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	**783.821**

*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.)

A transition rate was applied based on the best estimate of yield losses and feasibility associated with likely methyl bromidealternatives 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 bromiderequested. California pepper growers have also been added to this nomination based on new yield loss information they have submitted. USG also refined the estimates of the proportion of crop acreage to which methyl bromidealternatives involving 1,3 D + chloropicrin could not be used due to Karst and seepage irrigation restrictions. For details on these changes please see Appendices A and B.

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):

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

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in pepper production.
- Geographic distribution of key target pests: i.e., some alternatives may be comparable to methyl bromide as long as key pests occur at low pressure, and in such cases the U.S. is only nominating a CUE for peppers where the key pest pressure is moderate to high such as nutsedge in the Southeastern U.S..
- Regulatory constraints: e.g., 1,3 D use is limited in Georgia and Florida due to the presence of karst topography.
- Potential delay in planting and harvesting: e.g., the plant-back interval for 1,3 D + Chloropicrin may be up to two weeks longer than methyl bromide + chloropicrin. In Michigan an additional delay would occur because soil temperature must be higher to fumigate with alternatives. Delays in planting and harvesting may result in users missing key market windows, and adversely affect revenues through lower prices.

Michigan, Florida, Georgia, and the Southeastern U.S. (except Georgia and Florida) are each presented as separate regions in this nomination to reflect the separate applications from growers in these areas. A brief description of their need for methyl bromide follows, also presented on a regional basis.

TABLE A 2: EXECUTIVE SUMMARY*

Region		Southeast Pepper	Georgia Pepper	Florida Pepper	Michigan Pepper	California Pepper	Sector Total or Average
EPA Preliminary Value	kgs	210,911	347,183	1,230,822	15,195	36,287	1,840,399
EPA Amount of All Adjustments	kgs	(146,128)	(232,384)	(656,201)	(3,103)	(21,606)	(1,059,422)
Most Likely Impact Value for Treated Area	kgs	64,784	114,799	574,621	12,092	14,681	780,977
	ha	370	656	3,284	69	98	4,477
	Rate	175	175	175	175	150	174
Sector Research Amount (kgs)		2,844	2009 Total US Sector Nomination			783,821	

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

(ii) STATE WHETHER THE USE COVERED BY A CERTIFICATION 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).*

Not used to meet a certification standard.

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 Michigan pests 1,3 D + chloropicrin is the only key alternative with efficacy comparable to methyl bromide. Regulatory restrictions due to human exposure concerns, combined with technical limitations, reduce its use. Key factors are a potential delay in planting as long as 28 days, due both to label restrictions and low soil temperatures, and mandatory 30 to 100 meter buffers for treated fields near inhabited structures.

For the Southeastern United States, including Florida and Georgia, an application of 1,3-D + chloropicrin (Telone C35), along with a herbicide mix (e.g. clomazone + metolachlor) applied at bed formation, or Telone C35 followed by a chloropicrin or a metam application, may be the best available methyl bromide alternatives outside karst topographic features areas. In karst geology areas, including 31 counties in Florida, where Telone use is highly restricted, metam sodium or metam potassium remain at present the best alternatives. Although promising, these alternatives require further testing and validation on commercial fields.

In California, the registered alternative fumigants, fungicides, and nematicides are not as cost-effective and do not provide the same level of control of Phytophthora, Rhizoctonia, Verticillium, and Pythium as methyl bromide. One application of methyl bromide can last more than a year (within a particular field), whereas alternative chemicals must be applied annually.

There is evidence that the efficacy of metam-sodium declines in areas where it is repeatedly applied due to enhanced degradation of methyl isothiocyanate, the active ingredient, by soil microbes (Ashley et al. 1963, Ou et al. 1995, Verhagen et al. 1996, Gamliel et al. 2003).

All other available methyl bromide alternatives are currently technically infeasible for U.S. peppers.

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 IN 2003 (HA)	PROPORTION OF REQUEST FOR METHYL BROMIDE (%)
Michigan	816	16
Southeastern U.S. except Georgia and Florida	5,806	31
Georgia	2,899	80
Florida	7,893	104
California	10,659	7
NATIONAL TOTAL*	17,414	71

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(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.

In Michigan, areas not treated apparently do not have any infestation (i.e., zero oospores per unit soil) of the key fungal pests. Applicant states that soil infestation is spreading in the region annually. In southeastern U.S., Florida, and Georgia, areas not treated have low levels of nutsedge or nematodes in the pepper fields. In California the pathogen is not present in the areas that are not fumigated.

(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?

Better, more consistent pest control efficacy from the alternatives.

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 IN 2009

Region	Southeast US	Georgia	Florida	Michigan	California
Quantity Nominated	See Appendix A				
Total Crop Area (ha)	See Appendix A				
Methyl Bromide Use: Broadcast or Strip Treatment	Strip	Strip	Strip	Strip	Broadcast
Proportion of Area In Strips or Broadcast	58%	58%	58%	58%	100%
Formulation	67:33	67:33	Mostly 67:33	67:33 or 50:50	67:33
Application Rate In Treated Zone (kg/ha)	See Appendix A				
Dosage Rate (g/m^2)	See Appendix A				

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. Not applicable in this sector.
- Only the acreage experiencing one or more of the following impacts were included in the nominated amount: moderate to heavy key pest pressure, regulatory impacts, 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. USG also refined the estimates of the proportion of crop acreage to which methyl bromide alternatives involving 1,3 D + chloropicrin could not be used due to Karst and seepage irrigation restrictions. For details on these changes in usage requirements, please see Appendix B.

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

QUANTITY REQUESTED FOR PREVIOUS NOMINATION YEAR:	821,860 kg
QUANTITY APPROVED BY PARTIES FOR PREVIOUS NOMINATION YEAR:	756,339 kg
QUANTITY REQUIRED (KG) FOR YEAR TO WHICH THIS REAPPLICATION REFERS:	786,264 kg
TREATED AREA REQUIRED (HA) FOR YEAR TO WHICH THIS REAPPLICATION REFERS:	4477 ha

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 GENUS AND, IF KNOWN, TO SPECIES LEVEL	SPECIFIC REASONS WHY METHYL BROMIDE IS NEEDED
Michigan	Crown and root rots caused by soil-borne fungus Phytophthora capsici.	Fumigation operations need to be completed by the first week of May to allow growers to plant early and capture the early market for premium prices, as well as ensuring demand for their crop during the entire growing season (especially during the mid and late season).
Southeast U.S. Peppers Consortium excluding Florida and Georgia	Yellow and purple nutsedge (*Cyperus esculentus, C. rotundus*), [30%]; plant-parasitic nematodes (*Meloidogyne incognita; Pratylenchus sp.);* pythium root and collar rots (*P.irregulare, P. myriotylum, P. ultimum, P. aphanidermatum*); crown and root rot (*Phytophthora capsici*)	Only methyl bromide can effectively control the target pests found in the southeastern United States where pest pressures commonly exist at moderate to severe levels. Most, if not all of these states, are limited in the use of the alternative 1,3-D because of underlying karst topography throughout the region. Halosulfuron, while effective against nutsedge, is only registered for use on row middles in peppers. Metam-sodium has limited pest control capabilities and should never be used as a stand-alone fumigant (Noling, 2003).
Georgia	Yellow and purple nutsedge (*Cyperus esculentus, C. rotundus*) *[100%];* crown and Root rot (*Phytophthora capsici*) *[40%];* plant-parasitic nematodes (*Meloidogyne incognita; Pratylenchus sp) [70%];* southern blight (*Sclerotium rolfsii*) *[70%];* Pythium root and collar rots (*P.irregulare, P. myriotylum, P. ultimum, P. aphanidermatum*) *[100%]*	Only methyl bromide can effectively control the target pests found in the southeast U.S. where pest pressures commonly exist at moderate to severe levels. Most, if not all of these states are limited in the use of the alternative 1,3-D because of underlying karst topographic features throughout the region. Halosulfuron, which is registered only for middle-of-row use, does not control nutsedge near pepper plants where most competition occurs. Metam-sodium has limited pest control capabilities and should never be used as a stand-alone fumigant (Noling, 2003). Refer to Item 13 for additional detail.
California	Crown and root rots caused by soil-borne fungi – particularly *Phytophthora capsici;* Rhizoctonia, Verticillium, and Pythium *p*lant-parasitic nematodes, primarily root knot (*Meloidogyne* spp.)	Registered alternative fumigants, fungicides, and nematicides are not as cost-effective and do not provide the same level of pest control as methyl bromide. One application of methyl bromide can last more than a year (within a particular field), whereas alternative chemicals must be applied annually.

Florida	Weeds: yellow & purple nutsedges (*Cyperus rotundus & C. esculentus*), nightshade (*Solanum* spp.), white clover (*Trifollium repens*), ragweed (*Ambrosia artemisifolia*) Plant diseases: phytophthora blight (*Phytophthora* spp.), damping-off (*Rhizoctonia solani*, *Pythium* spp.), white mold (*Sclerotinia sclerotiorum*) Nematodes: root-knot nematodes (*Meloidogyne* spp.),	Only methyl bromide can effectively control the target pests found in Florida, where pest pressures commonly exist at moderate to severe levels. Use of 1,3-D is restricted in key pepper growing areas of Florida underlain by karst topographic features and sandy (porous) sub-soils, geological features that could lead to ground-water contamination. Approximately 40% of Florida's pepper production land has these soil constraints. For instance, 1,3-D is prohibited in Dade County, where 100% of the pepper growing area is affected (U.S. EPA, 2002, Noling, 2003). Metam-sodium has limited pest control capabilities and is not useful as a stand-alone fumigant (Noling, 2003). Halosulfuron, which is effective against nutsedge, is only registered for use in row middles in peppers.

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

TABLE B 2A: MICHIGAN - CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	MICHIGAN
CROP TYPE:	Pepper transplants for fruit production
ANNUAL OR PERENNIAL CROP:	Annual; generally 1 year
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Pepper – usually followed by an eggplant or pepper crop
SOIL TYPES:	Sandy loam; clay loam
FREQUENCY OF METHYL BROMIDE FUMIGATION:	1 time per year
OTHER RELEVANT FACTORS:	Key marketing opportunities have been established with Michigan's vegetable crop diversification and aims toward stable demands in the late spring and through the summer for Midwestern markets.

TABLE B 3A. MICHIGAN - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE FOR PEPPERS

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA Plant Hardiness zone 5b											
SOIL TEMP. (℃)	<10	10 - 15	15-20	20-25	20-25	20-25	20	10-15	<10	<10	<10	<10
RAINFALL (mm)	40	72	101	48	47	32	17	31	36	20	6	8
OUTSIDE TEMP. (℃)	0.2	7.4	12.1	17.5	20.6	20.9	18.1	8	2.4	-2.9	-8	-7
FUMIGATION SCHEDULE		X										
PLANTING SCHEDULE			X									
KEY MARKET WINDOW					X	X	X	X				

TABLE B 2B. SOUTHEAST U.S. PEPPERS CONSORTIUM EXCLUDING FLORIDA AND GEORGIA - CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	SOUTHEAST U.S. PEPPERS CONSORTIUM EXCLUDING FLORIDA AND GEORGIA
CROP TYPE:	Pepper transplants for fruit production
ANNUAL OR PERENNIAL CROP:	Annual; generally 1 year
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Pepper – usually double-cropped with a high-value cucurbit crop (muskmelon, cucumber, or squash).
SOIL TYPES:	Sandy loam; clay loam
FREQUENCY OF METHYL BROMIDE FUMIGATION:	1 time per year; (either in spring or fall)
OTHER RELEVANT FACTORS:	There are two distinct pepper-growing systems: 1) a spring crop (fumigation cycle begins in January) and a fall crop (fumigation cycle begins in May). Methyl bromide is applied 1 time per year on an individual field. Pepper does not follow pepper in this rotation; peppers are rotated with another crop, often a high-value cucurbit, which also depends on methyl bromide fumigation.

TABLE B 3B-1. SOUTHEAST U.S. PEPPERS CONSORTIUM EXCLUDING FLORIDA AND GEORGIA CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – JANUARY FUMIGATION (SPRING, EARLY SUMMER HARVEST)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
CLIMATIC ZONE	U.S. Plant Hardiness Zones 6b, 7a, 7b, 8a, 8b											
FUMIGATION SCHEDULE	X	X	X									
PLANTING SCHEDULE		X	X	X								
KEY HARVEST WINDOW				X	X	X	X					

TABLE B 3 B-2. SOUTHEAST U.S. PEPPERS CONSORTIUM EXCLUDING FLORIDA AND GEORGIA - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – SPRING FUMIGATION (FALL HARVEST)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
CLIMATIC ZONE	U.S. Plant Hardiness Zones 6b, 7a, 7b, 8a, 8b											
FUMIGATION SCHEDULE					X	X						
PLANTING SCHEDULE						X	X					
KEY HARVEST WINDOW								X	X	X	X	

TABLE B2 C. GEORGIA - CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	GEORGIA
CROP TYPE:	Pepper transplants for fruit production
ANNUAL OR PERENNIAL CROP:	Annual; generally 1 year
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Pepper – usually followed by a cucurbit crop (cucumbers or squash). Occasionally eggplants follow pepper crops.
SOIL TYPES:	Sandy loam; clay loam
FREQUENCY OF METHYL BROMIDE FUMIGATION:	1 time per year; (either in spring or fall)
OTHER RELEVANT FACTORS:	Actual frequency may be between 12 and 15 months depending on the number of crops grown per fumigation cycle.

TABLE B 3 C-1 GEORGIA - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – JULY FUMIGATION EVENT, PEPPER CROP IS HARVESTED IN FALL.

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	U.S. Plant Hardiness Zones 7a, 7b, 8a, 8b											
SOIL TEMP. *(°F)*	64.1	72.5	80.8	85.9	87.8	86.8	82.2	73.9	34.0	54.0	51.1	55.5
RAINFALL *(inches)*	5.0	3.8	3.5	4.5	5.6	4.8	3.4	2.3	2.3	4.5	4.5	4.2
AVERAGE AIR TEMP. *(℃)*	69.8	77.7	84.7	89.4	90.7	90.5	87.3	79.3	69.8	63.1	61.5	64.0
FUMIGATION SCHEDULE					X							
PLANTING SCHEDULE	**2C**				**P**							
KEY HARVEST WINDOWS			**2C**	**2C**	**2C**		**P**	**P**	**P**			

Methyl bromide applied in July allows the grower to economically produce at least two crops from one annual fumigation event. **P** = planting or harvest of pepper crop; **2C** = planting and/or harvest of 2[nd] crop.

TABLE B 3 C-2. GEORGIA -CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – SPRING (LATE FEBRUARY -MARCH) FUMIGATION EVENT, PEPPER CROP IS HARVESTED IN EARLY SUMMER

	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP T	OCT	NOV	DEC	JAN
CLIMATIC ZONE	U.S. Plant Hardiness Zones 7a, 7b, 8a, 8b											
SOIL TEMP. *(℃)*	Same as above- Table 11.2											
RAINFALL *(mm)*	Same as above- Table 11.2											
AIR TEMP. *(℃)*	Same as above- Table 11.2											
FUMIGATION SCHEDULE[A]	X											
PLANTING SCHEDULE[A,]		**P**				**2C**						
KEY HARVEST WINDOW[A,]				**P**	**P**	**P**		**2C**	**2C**	**2C**		

[A]Fumigation is an early spring event. Two crops are shown as being produced from one fumigation event.
P = planting and/or harvest of pepper crop; **2C** = planting and/or harvest of second crop.

TABLE B 2-D. FLORIDA -CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	FLORIDA
CROP TYPE:	Pepper transplants for fruit production
ANNUAL OR PERENNIAL CROP:	Annual (usually 1 yr)
TYPICAL CROP ROTATION) AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Eggplants or cucurbits
SOIL TYPES:	Sandy and sandy-loam soils
FREQUENCY OF METHYL BROMIDE FUMIGATION:	1 time per year
OTHER RELEVANT FACTORS:	Double-cropped with cucurbits

TABLE B 3 D-1 FLORIDA - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	Sept	Oct	NOV	DEC	JAN	FEB
Climatic Zones	Plant Hardiness Zones 9a; 9b; 10a, 10.											
Rainfall (mm), Tampa, FL	65.5	50.0	72.5	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8,
Outside Temp. (°C); Tampa, FL	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
Fumigation ScheduleA						X	X	X	X	X	X	
Transplanting Schedule; , non double-croppedB	X						X	X	X	X	X	X
Key harvest Window; non double-croppedC	X	X	X	X					X	X	X	X

[A] Non-double cropped: earliest start date: August 15; cells marked with an “x” represent variation in fumigation initiation amongst pepper growers.
[B] For Non-Double cropped pepper production, transplanting peppers is usually initiated around September 1; cells marked with an “x” represent variation in transplanting dates amongst pepper growers.
.[C] For Non-Double Cropped Peppers: Harvest Period usually begins as early as Nov. 15, and may continue until June 15, depending on when planted and weather conditions.

TABLE B 3 D-2. FLORIDA - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – PEPPERS DOUBLE CROPPED WITH ANOTHER VEGETABLE (USUALLY CUCURBITS)

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	Oct	NOV	DEC	JAN	FEB
Climatic Zones	Plant Hardiness Zones 9a; 9b; 10a, 10.											
Rainfall (mm), Tampa, FL	65.5	50.0	72.5	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8,
Outside Temp. (°C); Tampa, FL	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
Fumigation Schedule,; double-cropped [A]						X	X					
Transplanting Schedule; double-cropped [B]	**2C**	**2C**					**P**	**P**				**2C**
Key harvest Window; double-cropped [C]	**P**	**P**	**2C**	**2C**	**2C**				**P**	**P**	**P**	**P**

[A]Double-cropped; assumed to be with cucurbits; earliest start date is August 15; shaded cells represent variation in

fumigation initiation among pepper growers who double-crop.
[B]For Double-Cropped pepper production, transplanting (**P**) is typically initiated on September 1; variance can be until October 31. The second crop of cucurbits (usually) transplants (indicated by "**2C**") would typically be initiated around Feb 15, and may vary until April 30
[C] For Double Cropped peppers, Harvest Period usually begins as early as Nov. 15, (**P**), may continue until April 15, depending on when planted and weather conditions; Harvesting of second crop (**2C**) may start around May and continue until mid-July.
Climate Zone designation (http://www.usna.usda.gov/Hardzone)

TABLE B 2 E. CALIFORNIA - CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	MICHIGAN
CROP TYPE:	Pepper transplants for fruit production
ANNUAL OR PERENNIAL CROP:	Annual; generally 1 year
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Pepper – usually followed by an eggplant or pepper crop
SOIL TYPES:	Sandy loam; clay loam
FREQUENCY OF METHYL BROMIDE FUMIGATION:	1 time per year
OTHER RELEVANT FACTORS:	Key marketing opportunities have been established with Michigan's vegetable crop diversification and aims toward stable demands in the late spring and through the summer for Midwestern markets.

TABLE B 3 E. CALIFORNIA - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE FOR PEPPERS

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	USDA Plant Hardiness Zone 9b											
RAINFALL *(mm)A,B*	16.0 29.7	72.1 112.3	17.3 16.0	0 0	T 17.2	1.0 T	T 0	0 T	44.7 74.9	56.9 273.1	9.9 36.3	30.5 62.2
OUTSIDE TEMP. *(℃)[A]*	14.4 13.2	14.8 12.4	20.8 14.9	25.7 17.1	30.3 17.2	27.4 19.1	25.1 18.2	18.4 16.3	13.4 14.2	9.6 11.4	10.3 2.1	10.6 11.2
FUMIGATION SCHEDULE[C]								X*	X*	X*		
PLANTING SCHEDULE[C]											X	X
KEY MARKET WINDOW				X	X	X	X	X				

Notes:

* Fumigation occurs in these months, but only every other year, typically.
A Air temperatures and rainfall data were collected from weather stations in Fresno (top number) and at the San Francisco Airport (bottom number) from September to December 2002 and January to August, 2003.
[B]A "T" in the column denotes trace amount of rainfall recorded
[C] The above cycle is if another pepper crop followed the first planting of peppers. If other crops follow pepper, then planting of the other crops (e.g., a leafy vegetable) would begin in October and harvest would be in in December, January and February.

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

In Michigan, low soil temperatures (often below 10^{o} C) prior to the typical planting window inhibit dissipation of 1,3-D + chloropicrin (Martin, 2003), which can delay planting due to phytotoxicity to crop plants. There is also a 21-day planting delay as per registration label language. Combined, this results in a delay as long as 30 days in planting crops, which may negatively affect the economics of pepper production in this region. Metam sodium transformation into the active ingredient, methyl isothiocyanate, is also slowed by low soil temperatures (Ashley et al. 1963). Thus, optimal use of metam-sodium/potassium (even if effective against target pests) is likely to result in significant planting delays.

In the southeastern US, alternatives have not been effective against some of the key pests (particularly nutsedge) in this sector. In Florida and Georgia, karst topographic features prevents widespread application of 1,3 D + chloropicrin as an alternative for disease and nematode control, because regulatory restrictions prohibit use of this chemical on the overlying soils.

In Florida, methyl bromide continues to be the most consistent and reliable pest management alternative for the pest complex targeted by preplant fumigation. The variation and inconsistency with other alterantive fumigant products at the present time presents unacceptable risks to crop yield, crop quality, and potential economic returns.

In California, the registered alternative fumigants, fungicides, and nematicides are not as cost-effective and do not provide the same level of control of Phytophthora, Rhizoctonia, Verticillium, and Pythium as methyl bromide. One application of methyl bromide can last more than a year (within a particular field), whereas alternative chemicals must be applied annually.

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 B4 A. MICHIGAN -HISTORIC PATTERN OF USE OF METHYL BROMIDE ON PEPPERS

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	98	117	130	135	128	139
RATIO OF FLAT FUMIGATION USE TO STRIP/BED	No pepper area in Michigan uses flat fumigation application.					
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	11,747	14,001	15,618	16,230	15,391	16,715
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)* [A]	67:33	67:33	67:33 or 50:50	67:33 or 50:50	67:33 or 50:50	67:33 or 50:50
METHODS BY WHICH METHYL BROMIDE APPLIED	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm
DOSAGE RATE* (g/m^2) FOR THE ACTIVE INGREDIENT	12.0	12.0	12.0 or 8.9	12.0 or 8.9	12.0 or 8.9	12.0 or 8.9

[A] Growers have just started switching to the 50/50 formulation of methyl bromide/Chloropicrin since 2000 (about 5% of production acreage) to reduce cost per acre.

TABLE B 4 B. SOUTHEAST U.S. PEPPERS CONSORTIUM EXCLUDING FLORIDA AND GEORGIA - HISTORIC PATTERN OF USE OF METHYL BROMIDE ON PEPPERS

FOR AS MANY YEARS AS POSSIBLE AS SHOWN:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*[A]	880	809	809	991	1,153	1,329
RATIO OF FLAT FUMIGATION USE TO STRIP/BED USE	Not available					
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED [A] *(total kilograms)*	132,199	121,563	121,563	148,914	173,227	199,667
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	No definitive/substantiated information available			67:33	67:33	67:33
METHODS BY WHICH METHYL BROMIDE APPLIED	No information available			Injected 15 to 25 cm deep	Injected 15 to 25 cm deep	Injected 15 to 25 cm deep
DOSAGE RATE* (G/HA) FOR THE ACTIVE INGREDIENT	15.0	15.0	15.0	15.0	15.0	15.0

[A] An increase in the acreage of peppers produced in the Southeastern U.S. (relative to the initial nomination) is due to the addition of two new states (added since 2001): Kentucky and Louisiana.
[B] Based on estimated area: 2,023 to 2,415 m^2 (Lewis, 2003, personal communication).

TABLE B4 C. GEORGIA - HISTORIC PATTERN OF USE OF METHYL BROMIDE ON PEPPERS

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
AREA TREATED *(hectares)*	1,767	2,263	2,252	2,312	2,117	2,432
RATIO OF FLAT FUMIGATION USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	All production acreage is strip/bed fumigation and tarped with LDPE films. Approximately 58% of the field is treated with methyl bromide and covered with plastic mulch.					
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	337,163	347,944	338,248	347,183	317,886	365,235
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	98:2	98:2 (15% area) 67:33 (85% Of area)	67:33	67:33	67:33	67:33
METHODS BY WHICH METHYL BROMIDE APPLIED	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp
DOSAGE RATE*(G/M^2) OF ACTIVE INGREDIENT	19.1	15.4	15.0	15.0	15.0	15.0

TABLE B 4 D. FLORIDA - HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN :	1999	2000	2001	2002	2003	2004
AREA TREATED *(HECTARES)*	8,903	8,741	8,741	8,195	8,417	8,701
RATIO OF FLAT FUMIGATION USE TO STRIP/BED USE	100% strip treatments are used in this region					
AMOUNT OF ACTIVE INGREDIENT USED *(TOTAL KILOGRAMS)*	1,644,501	1,431,639	1,406,135	1,285,199	1,320,860	1,338,006
FORMULATIONS OF METHYL BROMIDE *(METHYL BROMIDE /CHLOROPICRIN)*[A]	98:2 & 67:33	98:2 & 67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED [A]	Sweptback chisel-shank, 25-30.5 cm.deep	Sweptback chisel-shank, 25-30.5 cm.deep	Sweptback chisel-shank, 25-30.5 cm.deep	Sweptback chisel-shank, 25-30.5 cm.deep	Sweptback chisel-shank, 25-30.5 cm.deep	Sweptback chisel-shank, 25-30.5 cm.deep
DOSAGE RATE OF STRIP/ BED, G MB/M^2	18.5	16.4	16.1	15.7	15.7	15.4

[A] Sources: personal communication, Professor J.W. Noling, November 25, 2003; M. Aerts, December 2, 2003.

TABLE B 4 E. CALIFORNIA -HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN :	1999	2000	2001	2002	2003	2004
AREA TREATED *(HECTARES)*	1,226	995	447	121	304	280
RATIO OF FLAT FUMIGATION USE TO STRIP/BED USE	Ratio of Flat Fumigation treatments versus bed applications is not known. Two methods of application are used: Flat-fumed type, and methyl bromide is injected, and sealed with plastic ground cover. If buffer zones are strict (e.g., in southern Santa Clara County), then almost all applications are flat-fumed, Flat Fumigation. The second type of application involves bed-fumed (~0.67 A, or 29,000 sq. ft)					
AMOUNT OF ACTIVE INGREDIENT USED *(TOTAL KILOGRAMS)*	247,191	170,830	63,558	25,929	53,206	58,300
FORMULATIONS OF METHYL BROMIDE *(METHYL BROMIDE /CHLOROPICRIN)*[A]	75:25 or 67:33	75:25 or 67:33	75:25 or 67:33	75:25 or 67:33	75:25 or 67:33	75:25 or 67:33
METHOD BY WHICH METHYL BROMIDE APPLIED [A]	Flat-fumed or bed fumed, injected 16-36 cm deep	Flat-fumed or bed fumed, injected 16-36 cm deep	Flat-fumed or bed fumed, injected 16-36 cm deep	Flat-fumed or bed fumed, injected 16-36 cm deep	Flat-fumed or bed fumed, injected 16-36 cm deep	Flat-fumed or bed fumed, injected 16-36 cm deep
DOSAGE RATE OF STRIP/ BED, G MB/M^2	202	172	142	214	175	208

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
Metam-sodium or Metam-potassium	In Michigan, pepper farmers requesting methyl bromide must plant by the first week of May to capture an early market window. Soil fumigation must therefore be completed by mid April to allow 14-21 days for aeration. However, metam labels recommend that applications be made when soil temperatures (at application depth) are above 4.4°C. Since soil temperatures in Michigan do not climb over 10°C until after mid to late May (Schaetzl and Tomczak, 2001), metam products cannot be used effectively for early pepper planting in Michigan. Metam products have the additional disadvantage that when the soil is wet and cold (below 15°C), the minimum recommended plant back period is 30 days, which would further move the crop beyond the early market window. In addition, control of the key pests is inconsistent (Locascio et al. 1997, Martin 2003). In the cool conditions of Michigan, metam-sodium is likely to be slow to transform into the active ingredient (methyl isothiocyanate), which also suggests that pest control will not be as effective as with methyl bromide (Ashley et al. 1963). In a recent study conducted in Oceana County, Michigan by Hausbeck and Cortright (2004), yields from pepper plots treated with metam potassium (K-Pam) were comparable to yields from control plots and plots treated with methyl bromide + chloropicrin, indicating e a very low pest (P. capsici) pressure at the test site. In addition, there is a 14-30 day waiting period at the time of application until planting, compared to 14 days for methyl bromide. Such a delay could cause the higher-end market windows to be missed, particularly for the spring plantings (i.e., fall harvests). Beginning the application cycle earlier is not an option since crops from the previous fumigation cycle must be cleaned up prior to metam application. (Georgia CUE # 03-0049; Kelley, 2003). Repeated applications of MITC (the breakdown product of metam sodium) are known to enhance its biodegradation and reduce efficacy as a result of increased populations of adapted microorganisms (Dungan and Yates, 2003).

Soil solarization	Michigan's climate is typically cool (often less than 11 °C through May) and cloudy, particularly early in the growing season when control of the key pests is especially important. In Michigan, the growing season is short (May to September), and the time needed to utilize solarization is likely to render the subsequent growing of crops impossible, even if it did somehow eliminate all fungal pathogens. Since solarization has shown promise in other crops and regions (e.g., tomatoes in Florida), the potential for adoption exists (Schneider et al. 2003). However, because of climate, solarization is not feasible in Michigan. For nutsedge control in the southeastern United States, solarization is not technically feasible as a methyl bromide alternative. Response of *Cyperus* species to solarization is sporadic and not well understood; data show solarization to provide, at best, suppression of nutsedge populations (Chase et al. 1999). Research indicates that the lethal temperature for nutsedge tubers is 50°C or higher. Trials conducted in mid-summer in Georgia resulted in maximum soil temperatures of 43 °C at 5 cm depth (Chase et al. 1999). Thus, solarization, even in the warmer months in southern states, did not result in temperatures high enough to destroy nutsedge tubers. Also, tubers lodged deeper in the soil would be completely unaffected. In addition, solarization would take fields out of production since it would be needed during the spring and into the summer months, which are optimal for pepper production, except in Florida..
Steam	While steam has been used effectively against fungal pests in protected production systems, such as greenhouses, there is no evidence that it would be effective in open field pepper crops in Michigan. Any such system would also require large amounts of energy and water to provide sufficient steam necessary to sterilize soil down to the rooting depth of field crops (at least 20-50 cm).
Biological Control	Biological control agents are not technically feasible alternatives to methyl bromide because they alone cannot control the soil pathogens that afflict peppers in Michigan. The bacterium *Burkholderiaia cepacia* and the fungus *Gliocladium virens* have shown some potential in controlling some fungal plant pathogens (Larkin and Fravel 1998). However, in a test conducted by the Michigan applicants, *P. capsici* was not controlled adequately in summer squash by either of these beneficial microorganisms. Furthermore, no biological control agent has been identified to effectively control nutsedge or *Phytophthora.* Therefore, biological control is not a stand-along replacement for methyl bromide in pepper crops.
Cover crops and mulching	There is no evidence these practices effectively substitute for the control methyl bromide provides against *P. capsici.* Control of *P.capsici* is imperative for pepper production in Michigan. Plastic mulch is already in widespread use in Michigan vegetables, and regional crop experts state that it is not an adequate protectant when used without methyl bromide. The longevity and resistance of *P. capsici* oospores renders cover crops ineffective as a management alternative to methyl bromide. Also, there is no evidence these practices effectively substitute for the control methyl bromide provides against nutsedges (Burgos and Talbert 1996). Some cover crops that have been shown to reduce weed populations also reduced or delayed crop maturity and/or emergence, as well as yields (Burgos and Talbert 1996, Galloway and Weston 1996). Mulching has also been shown to be ineffective in controlling nutsedges, which are able to penetrate through both organic and plastic mulches (Munn 1992, Patterson 1998).
Crop rotation and fallow land	The crop rotations available to growers in Michigan region are also susceptible to these fungi, particularly to *P. capsici*. Fallow land can still harbor *P. capsici* oospores (Lamour and Hausbeck 2003). Thus fungi would persist and attack peppers if crop rotation/fallow land was the main management regime.
Endophytes	Though these organisms (bacteria and fungi that grow symbiotically or as parasites within plants) have been shown to suppress some plant pathogens in cucumber, there is no such information for the other pepper crops grown in Michigan. Furthermore, the pathogens involved did not include *Phytophthora* species, which are arguably the greatest single threat to Michigan peppers.

Flooding/Water management	Flooding is not technically feasible as an alternative because it does not have any suppressive effect on *P. capsici* (Allen et al. 1999), and is likely to be impractical for Michigan pepper growers. It is unclear whether irrigation methods in this region could be adapted to incorporate flooding or alter water management for pepper fields. In any case, there appears to be no supporting evidence for its use against the hardy oospores of *P. capsici*.
Grafting/ resistant rootstock/ plant breeding/ soilless culture/ organic production/ substrates/ plug plants.	Due to the paucity of scientific information on the utility of these alternatives as methyl bromide replacements in peppers, they have been grouped together for discussion in this document. There are no studies documenting the commercial availability of resistant rootstock immune to the fungal pathogens or weeds listed as major pepper pests. Grafting and plant breeding are thus also rendered technically infeasible as methyl bromide alternatives for control of *Phytophthora* fungi. Soilless culture, organic production, and substrates/plug plants are also not technically viable alternatives to methyl bromide for fungi. One of the fungal pests listed by Michigan can spread through water (Gevens and Hausbeck 2003), making it difficult to keep any sort of area (with or without soil) disease free. Various aspects of organic production - e.g., cover crops, fallow land, and steam sterilization - have already been addressed in this document and assessed to be technically infeasible methyl bromide alternatives.
Metam sodium or metam potassium + Chloropicrin	Pepper farmers requesting methyl bromide must plant by the first week of May (or August to September in Florida) to capture an early market window. Soil fumigation must therefore be completed by mid April (or fall/winter in Florida) to allow 14-21 days for aeration. However, metam labels recommend that applications be made when soil temperatures (at application depth) are above 4.4°C. Since soil temperatures in Michigan do not climb over 10°C until after mid to late May (Schaetzl and Tomczak, 2001), metam products cannot be used effectively for early pepper planting in Michigan. Metam products have the additional disadvantage that when the soil is wet and cold (below 15°C), the minimum recommended plant back period is 30 days, which would further move the crop beyond the early market window. In addition, trials in tomato have shown inconsistent efficacy of this formulation against fungal pests, though it is generally better than metam-sodium alone (Locascio and Dickson 1998, Csinos et al. 1999). These studies apparently did not measure yield impacts, and did not involve peppers. Hausbeck and Cortright (2004) evaluated several soil fumigants for control of P. capsici on several vegetable crops, including peppers, in Michigan. Results show that yields from pepper plots treated with metam potassium + chloropicrin were comparable to yields from control plots and from plots treated with methyl bromide + chloropicrin. These results point to a very low pest pressure in the study area. Further studies are necessary to clearly identify methyl bromide alternatives. For weed pests, a study with vegetables showed control of yellow nutsedge, but weed pressure in that small plot test was low, according to the authors (Csinos et al. 1999). Gilreath et al (2005) also reported control of nutsedge with metam + pic, but it was not as consistent as control with methyl bromide.

1,3 dichloropropene + chloropicrin	Regulatory restrictions and Michigan's cool and wet soils may result in a delay of up to 28 days in planting after treatment with this combination. This delay could result in growers missing key market windows, with consequent negative economic impacts (detailed in other sections below). In a small plot study conducted in Michigan by Hausbeck and Cortright (2004) pepper yields from plots treated with 1,3-D + chloropicrin were comparable to yields from control plots and plots treated with methyl bromide + chloropicrin. These results seem to indicate a very low *P. capsici* pressure at the test site. Further studies continue to be necessary to clearly identify methyl bromide alternatives. In Florida, this combination, by itself, is not effective in areas with moderate to high nutsedge pressure. Applications via micro-irrigation systems have yielded mixed results, probably due to poor lateral distribution of the chemical in the soil (Martin 2003; Dungan and Yates, 2003). In addition, 1,3-D's use is prohibited due to groundwater contamination in areas with karst topographic features (see Appendix B). In Dade County this combination is not allowed at all. Culpepper and Langston (2004) tested the effectiveness of several soil fumigant combinations for the management of nutsedges and nematodes affecting peppers in Tifton, Georgia. Results show that 1,3-D, followed by chloropicrin, was significantly less effective than methyl bromide for the control of both purple and yellow nutsedge, but as effective as methyl bromide for the control soil nematodes. In terms of spring and fall crop yield, however, this combination performed as well as methyl bromide. This treatment is promising and will require further testing and validation in commercial fields.
1,3 dichloropropene + Metam-sodium	Trials in tomato have shown inconsistent efficacy of this combination against fungal pests, though it is generally better than metam-sodium alone (Csinos et al. 1999). Low efficacy in even small-plot trials indicates that this is not a technically feasible alternative for commercially produced peppers in Michigan at this time. These studies apparently did not measure yield impacts, and did not involve peppers. Regarding pests in the southern US, this combination controls nematodes but not nutsedges. In a study with vegetables, it provided control of yellow nutsedge, but weed pressure in that small plot test was low, according to the authors (Csinos et al. 1999). It is inconsistently effective against fungal pests (see Michigan sections for more discussion). 1,3-D is also subject to regulatory prohibition of use on Karst topographic features.

14. LIST AND DISCUSS WHY REGISTERED PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE

Assuming that an herbicide is used that is as effective as pebulate, growers using a 1,3-D + chloropicrin + herbicide mixture may suffer an average of 0 to 27 percent yield losses (Santos *et al*, 2006; Chellemi *et al*., 2001). As the United States has consistently stated, our experience in that a 20% yield loss will force growers to no longer produce a crop.

TABLE C 2. TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
Halosulfuron-methyl	For nutsedges: potential crop injury; plant back restrictions. Efficacy is lowered in rainy conditions (which are common in this region). Also, a 24-month plant back restriction may cause significant economic disruption if growers must rely on this control option. Halosulfuron is registered for use in row middles only and is only effective as a postemergence product.
Glyphosate	For nutsedges: Non-selective; for row middles only, will not control nutsedge in the plant rows; does not provide residual control
Paraquat	Non-selective for use on row middles only does not provide residual control. Another weed, nightshade, has shown resistance to paraquat, a dangerous development since this plant serves as a reservoir for many insects (e.g., whiteflies and pepper weevils), that are vectors of pepper diseases (Aerts, 2004)
s-metolachlor	Although s-metolachlor (Dual Magnum) and napropamide (Devrinol) were cited as herbicides with some potential to control nutsedges, their efficacy in sub-tropical Florida is inconsistent (Noling, 2003). Furthermore, s-metolachlor's effectiveness is restricted to yellow nutsedge. Phytotoxicity to different pepper cultivars has yet to be determined.
napropamide	Although napropamide (Devrinol) was cited as herbicides with some potential to control nutsedges, its efficacy in all areas is inconsistent (Noling, 2003). Napropamide effectiveness is restricted to yellow nutsedge. Phytotoxicity to different pepper cultivars has yet to be determined.
1,3 D + chloropicrin+ a herbicide (such as napropamide + s-metolachlor + halosulfuron)	A combination of fumigants and herbicide partners is the most promising alternative for the control of all key pests in the regions. The executive summary of dozens of research trials show that the growers may harvest tomato yield that is equal or nearly equal to yields obtained using methyl bromide and chloropicrin. With this combination, in areas where it can be used, growers may lose an average between 0 and 6.2% yield (Santos et al, 2006; Chellemi *et al*., 2001).
Metam sodium + Chloropicrin	Although this combination may be more effective than metam sodium alone in controlling fungal pests, it would not prevent yield losses caused by nutsedges and some species of nematodes. This mixture along with an herbicide (for controlling nutsedge weeds) may be a viable methyl bromide alternative in the South-Eastern and mid-Atlantic United States, where growers cannot use telone due to karst topographic features and shallow water tables, respectively. Further studies need to be undertaken to ascertain whether or not it is technically and economically viable.
1,3 D + Chloropicrin	This combination is effective against nematodes and fungal plant pathogens, but not against nutsedge and other weeds in the Southeastern US. Approximately 40 % and 8.0% of tomato land in Florida and Georgia, respectively, has Karst topographic features. Therefore growers in these areas cannot use telone because of state and federal regulations and underground water contamination issues. In the coastal Mid-Atlantic (e.g. North Carolina) high water tables and the close proximity of production areas to environmentally sensitive estuaries makes the use of 1,3-D limited

Note: When nutsedge pressure is moderate to severe, 1,3-D + chloropicrin is not technically feasible because it needs to be coupled with an effective herbicide to provide control for the entire growing season (U.S. EPA, 2002). Frank et al (1992) reported that weeds in pepper for 40 to 60 days could reduce yields by 10 to 50 percent. Stall and Morales-Payan reported that tomato must be nutsedge-free for 2 to10 weeks to keep yield reductions below 5 percent. There are no herbicides which control purple nutsedge in the crop row. Paraquat and glyphosate will suppress emerged nutsedge, but cannot be used in the crop row because of potential crop injury (SE Pepper Consortium CUE 02-0041).

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

MICHIGAN REGION

In 2003, the applicant submitted the results of one small scale field trial on the efficacy of methyl bromide alternatives in controlling *Phytophthora capsici* and its effect on tomato yield (Hausbeck and Cortright, 2003). This study focused on tomato and a number of vegetable crops (cucurbits, winter squash, and melons). As of July 2003, results showed that methyl bromide+ chloropicrin (67/33, shank injected at 390 a.i. kg/ha), metam sodium (drip applied) at 355 kg a.i. kg/ha), 1, 3-D+chloropicrin (65/35, shank injected at 150 liters/ha) resulted in 0, 12.9, 6.4 percent plant loss. Untreated control suffered 7.1% plant loss. The fields were treated on May 15 and 16, 2003, and the weather was unusually cooler than normal during May and early June of the year 2003. Results were inconclusive. The state expert claims that the growers may suffer 6.4 and 12.9 percent yield losses using 1, 3-D + chloropicrin and metam sodium if fields are fumigated in early May instead of April (using methyl bromide + chloropicrin). In addition, growers may also experience revenue losses if they miss early tomato market when prices are higher.

This study was repeated during the 2004 growing season. However, this study does not represent the typical Michigan conditions because due to the cool wet weather the plots were not treated until June 8 when the soil was warm enough for the alternatives to be effective. Results show that yields from tomato plots treated with metam potassium (K-Pam), alone or in combination with chloropicrin, and from plots treated with 1,3-D + chloropicrin (Telone C-35) are not significantly different from yields from plots treated with methyl bromide + chloropicrin or from yields from untreated control plots (Hausbeck and Cortright, 2004). As for the 2003 trial discussed above, results of the 2004 study are still inconclusive, probably because of the occurrence of low pest pressure in the study area.

TABLE C 3. MICHIGAN: EVALUATION OF FUMIGANTS FOR MANAGING PHYTOPHTHORA CROWN AND FRUIT ROT OF SOLANACEOUS AND CUCURBIT CROPS 2004

Alternative & Rate	Plant Loss (%)	Marketable Yield Loss
methyl bromide 67:33 350 lb/A)	4.6 %	0%
Telone C-35 shank (392 gal/A)	15.3 %	30%
Chloropicrin shank (344 lb/A) plus Metam potassium drip (174 lb/A)	0.60%	-23%
Chloropicrin shank (344 lb/A) plus Metam potassium drip (348 lb/A)	0.40%	-12%
Chloropicrin 99% shank (25 gal)	24.30%	11%
Metam potassium drip (348 lb/A)	1.70%	-17%
Metam potassium drip (174 lb/A)	2.10%	7%

Footnote: Due to a wet spring the treatments were applied later than typical for Michigan on June 8, 2004. From Hausbeck and Cortright, 2004.

A field trial was conducted in small plots in 2004 in Michigan by Hausbeck and Cortright (2004) of Michigan State University. This study examined a number of vegetable crops including the cucurbits zucchini, acorn squash, and melons. Results, submitted with their 2004 CUE request, indicated that 1,3 D + 35 % chloropicrin treatments (shank-injected at 56.7 liters/ha) showed an average of 44% yield loss compared to methyl bromide (due to both *Phytophthora* and *Fusarium* combined). Chloropicrin alone (shank-injected at 233.6 l/ha) showed an average 15.5% loss compared to methyl bromide. Metam-potassium showed yields similar to those seen with methyl bromide.

Metam-sodium was not tested, but can reasonably be assumed to be equivalent to metam-potassium (since the active ingredient is identical). Methyl iodide (currently unregistered for peppers) with 33% chloropicrin (shank-injected, at 36.8 kg/ha, respectively), also showed yields similar to that of methyl bromide. It should be noted that even large differences in average yields across various treatments were often not statistically significant, suggesting that there was high variability in the data. Thus far, no new data have been generated to complement this work, though further research is planned (see Section 17 below).

In studies with other vegetable crops, 1, 3 D + chloropicrin has generally shown better control of fungi than metam-sodium formulations (though still not as good as control with methyl bromide). For example, in a study using a bell pepper/squash rotation in small plots, Webster et al. (2001) found significantly lower fungal populations with 1,3 D + 35 % chloropicrin (drip applied, 146 kg/ha of 1,3 D), as compared to the untreated control. However, methyl bromide (440 kg/ha, shank-injected) reduced fungal populations even more. It should be noted that *P. capsici* was not present in test plots, though *Fusarium* spp. were. Methyl iodide had no significant suppressive effect, as compared to the untreated control. However, neither of these methyl bromide alternatives increased squash fruit weight significantly over the untreated control. Indeed, as compared to the methyl bromide standard treatment plots, squash fruit weight was 63 % lower in the 1,3 D plots, and 41 % lower in the methyl iodide plots. The proportion of marketable squash fruit (defined only as those fruit so bad as to have to be discarded) in the 1,3 D plots was 30 % lower than that in the methyl bromide plots, though in the methyl iodide plots it was equivalent to methyl bromide.

SOUTHEAST REGION

In another study conducted on tomatoes, Gilreath et al. (1994) found that metam-sodium treatments did not match methyl bromide in terms of plant vigor at the end of the season; again, *Fusarium* (but not *P. capsici*) was one of several pests present.

Taken together, these studies indicate that, while the recent trials in Michigan are promising for the use of metam-sodium/potassium + chloropicrin, there is still great inconsistency in efficacy and protection from yield losses. Further, no large scale field trials have yet been performed to demonstrate reliable, consistent pest control similar to that of methyl bromide in the pepper growing regions of Michigan. Given the highly variable results with this methyl bromide alternative, EPA decided that the best case yield loss scenario would be a level similar to what was assessed in the 2005.

TABLE C 4. SOUTH-EASTERN US: FRESH MARKET TOMATO FUMIGATION TRIAL

Treatment	Fusarium Wilt† Incidence (19 WAT)	Diseased Plants† *Ralstonia solanacearum* *(19 WAT)*	*Cyperus* spp. ‡ (plants/m^2) (17 WAT)	Marketable§ Yield Loss Using methyl bromide+ Pic as Standard
Me Br + Pic (67:33) (400 kg/ha)	3.8%	0%	11.5	0%
1,3-D + Pic (65:35) & napropamide+halosulfuron (330L/ha, 2.3kg +71g/ha)	5.0%	0%	11.5	0-4%
1,3-D + Pic (65:35) & metolachlor & trifloxysulfuron (330L/ha, 840g+5.3g/ha)	2.5%	0%	12.5	0-7%
Pic & MNa (170kg/ha & 710 L/ha)	0%	2.5*	3.5	0-2%

Footnotes: Santos, M.S., JP Gilreath, TN Motis, JW Noling, JP Jones, and JA Norton. 2006
WAT=Weeks After Treatment
*Within column data is significantly different from methyl bromider+Pic (P=0.05)
†Data was obtained from Table 1, Spring 2003 since this part of the study was the only one to evaluate both *Fusarium* and *Ralstonia*.
‡Data was obtained from Table 4, Spring 2004 since the pest pressure was the highest of all three-harvest times.
§Yield data presented was for spring and fall 2003

TABLE C 5. SOUTH EASTERN US: EFFICACY OF METHYL BROMIDE ALTERNATIVES FOR VERTICILLIUM AND WEED MANAGEMENT IN TOMATOES

Treatment	*Verticillium dahliae Infected (%) 2004*	Weeds per meter^2 (Aug 19, 2004)	Marketable Yield Loss 2003
methyl bromide 67:33 (268 + 132 lb/A)	29	0	0%
Telone C-35 shank (35 gal/A)	17.4	5.8	4%
Telone InLine C-35 drip (35 gal/A)	-	-	13%
Chloropicrin 99% (150 gal)	24.2	26.5	14%
Metam sodium drip (75 gal/A)	-	-	8%
Metam sodium spray/till (75 gal/A)	-	-	15%
Tri chlor EC (200 lb/A)		-	22%

Footnote: Louws, F.J., L.M. Ferguson, K. Ivors, J. Driver, K. Jennings, D. Milks, P.B. Shoemaker & D.W. Monks. 2004

TABLE C 6. SOUTH EASTERN US METHYL BROMIDE ALTERNATIVES IN TOMATO PRODUCTION SYSTEMS IN NORTH CAROLINA

Treatment	*Verticillium dahliae Rating* (July 7, 2002)	Marketable Yield Loss
methyl bromide 67:33 (268 + 132 lb/A)	4.9bc	0%
Telone C-35 shank (35 gal/A)	10.6 bc	-3%
Telone InLine C-35 drip (35 gal/A)	24.6 ab	5%
Chloropicrin shank (15 gal)	0 c	-4%
Metam sodium drip (75 gal/A)	13.4 abc	2%
Metam sodium spray/till (75 gal/A)	9.3 bc	5%
Tri chlor EC (200 lb/A)	17.6 abc	9%
Tri chlor EC (200 lb/A) 1 week delay Metam (75 gal/A)	15.1	7%

Footnote: Louws, F.J., L.M. Ferguson, N.P. Lynch, & P. B. Shoemaker. 2002

TABLE C 7. SOUTH EASTERN PEPPER YIELDS ARE NOT SIGNIFICANTLY DIFFERENT BUT PERCENT YIELD LOSS CAN BE LARGE

	Treatment	Use Rate kg/ha	Yield t/ha	% Change
1	Untreated		9.5	-31%
2	methyl bromide + Pic LDPE	392	13.8	0%
3	methyl bromide + Pic VIF Plastopil	196	10.8	-22%
4	methyl bromide + Pic VIF Plastopil	98	13.6	1%
5	methyl bromide + Pic VIF Vikase	196	11.4	-17%
6	methyl bromide + Pic VIF Vikase	98	11.9	-14%

Footnote: From Gilreath et al. 2005. Crop Protection 24: 285-287. LDPE is low density polyethylene

Another study by Gilreath, Santos, Motis, Noling and Mirusso (2005) looks at nematode and *Cyperus* control in bell pepper (*Capsicum annum*). In that study the authors state "For bell pepper yield, the application of metam sodium and metam sodium + chloropicrin provided similar fruit weight as for methy bromide + chloropicrin in two of the three seasons." However, in that one year (Fall 2002) the yields went from 18.8 t/ha for methyl bromide + chloropicrin to 13.7 t/ha for metam sodium + chloropicrin. In a different study evaluating nematode populations and tomato yields, Gilreath et al (2006) found that the most efficacious treatment was Telone C35, Pic, Pebulate + trifluralin. However, pebulate was never registered on peppers so this herbicide was not available to provide weed control in that crop. As discussed above, this treatment is problematic on more than one level. Overall the level of yield loss could have severe economic impacts for a grower. Because of the inconsistency of some of the alternative treatments, the U.S. does not consider them to be a replacement for methyl bromide.

TABLE C 8. DATA ON TRIALS OF FUMIGANT ALTERNATIVES TO METHYL BROMIDE FOR POLYETHYLENE-MULCHED TOMATO (LOCASCIO ET AL. 1997)

Chemicals	Rate (kg/ha)	Average Nutsedge Density (#/m^2)	Average Marketable Yield (ton/ha)	% Yield Loss (compared to methyl bromide)
Untreated (control)	-	300 [ab]	20.1 [a]	59.1
methyl bromide + Pic (67-33), chisel-injected	390 kg	90 [c]	49.1 [b]	---
1,3 D + Pic (83-17), chisel-injected	327 l	340 [a]	34.6 [c]	29.5
Metam Na, Flat Fumigation	300 l	320 [a]	22.6 [a]	54.0
Metam Na, drip irrigated	300 l	220 [b]	32.3 [c]	34.2

For nutsedge pests, which are widespread in all requesting regions except Michigan, pepper growers do not currently have technically feasible alternatives to methyl bromide use at planting. Metam-sodium and 1,3 D + chloropicrin have shown some efficacy in small-plot trials in other vegetable crops (e.g, tomato). However, at best, metam sodium may allow at least 44 % yield loss, while 1,3 D may allow at least 29 % loss. Both often show less control than methyl bromide (in terms of population suppression) of nutsedges. These factors suggest that even this alternative will not be economically feasible even in the best-case technical scenario. It should be noted that there is evidence that both 1,3 D and methyl isothiocynate levels decline more rapidly, thus further compromising efficacy, in areas where these are repeatedly applied (Smelt et al., 1989; Ou et al., 1995; Gamliel et al., 2003). This is due to enhanced degradation of these chemicals by soil microbes (Dungan and Yates, 2003). Other chemical alternatives to methyl bromide that have shown promise against nutsedges (e.g., pebulate) are currently unregistered for peppers, and are often not being developed for registration by any commercial entity.

In one recent study, Culpepper and Langston (2004) conducted studies at 2 sites in spring 2003 and one site in fall 2004. Plot sizes were 20 feet X 32 inches (4.94 m^2). Treatments were: Methyl bromide standard (67:33 formulation), untreated control, 2 formulations of Telone (1,3 D + chloropicrin) at various doses, followed by an additional application of either chloropicrin or metam-sodium, a third formulation of 1,3 D + chloropicrin (“Inline”), and methyl iodide. An additional set of plots received the same fumigant treatments but also received an herbicide treatment (clomazone + halosulfuron) later in the season.

Watermelon – the only cucurbit crop addressed in these experiments – showed no significant (final) yield differences across any fumigant treatment. The same lack of difference was observed when herbicides were added. In fact, there was no difference in yield even when pesticide treatments were compared to the untreated control. However, nutsedge populations in the study appeared to be relatively low (e.g., 667 plants per plot or 135/m^2, in the untreated control, at the end of the study).

In 2003 and 2004 research in Florida (Wang et al, 2006) compared the effects of methyl bromide fumigation to solarization, cowpea cover crop, and solarization with cow peas for control of: nematodes, Pythium, and weeds, and pepper crop yield. Solarization treatments improved yield compared to methyl bromide but in both years the untreated control provided similar crop yield to the mtheyl bromide treatment suggesting that the pest pressure was not sufficient to reduce crop yield.

Research in Florida in 2006 (Rosskoph et all 2006) compared methyl bromide:chloropicrin (67:33 at 392 kg/ha) and Midas™ iodomethane:chloropicrin (50:50 at 336 kg/ha) for weed control and Phytophthora blight control in bell peppers. Weed densities of nutsedge (*Cyperus spp.),* goosegrass *(Elucine indic*a) and dogfennel (*Eupatorium capillifolium*) were generally higher in the idodmethane:chloropicrin treated plots than in the methyl bromide:chloropicrin treated plots*)*. The incidence of *Phytophthora capsici* at 163 days after transplanting was similar in both treatments. Pepper crop yield was not presented.

Research in Georgia in 2006 compared methyl bromide: chloropicrin (67:33 at 392 kg/ha) to 1,3-dichloropropene followed by chloropicrin followed by metam sodium (12 gal [9.8475 lb/gal or 132 kg/ha] plus 168 kg plus 75 gallons [4.25 lb/gal or 357 kg/ha]) using low density polyethylene – white on black, metalized film – silver on black, and virtually impermeable film (VIF) – grey on black. The research indicated that the three way combination could produce yields similar to methyl bromide + chloropicrin treatments when the following problems have been overcome: the interval between fumigating and planting is similar between treatments, additional colors of the plastic mulch become available, the life span of the mulches has been increased, the higher price of mulches must be overcome by efficacious lower rates, the application procedures of the three way mix can be better understood, and the difference in performance between spring and fall applications in Georgia.

TABLE C 9. NUMBER OF PURPLE NUTSEDGE PLANTS PER PLOT WITH DIFFERENT TREATMENTS AND FILMS. FALL 2006

Treatment	Rate (kg/ha) Under LDPE	Low Density Polyethylene Film (LDPE)	Rate (kg/ha) Under MS and VIF	Metalized Film (MS)	Virtually Impermeable Film (VIF)
Film Color		**White on black**		**Silver on black**	**Grey on black**
Untreated	0	96 d	**0**	60 c	92 d
Iodomethane: chloropicrin	50:50 ratio at 392	1 a	**50:50 at 196**	1 a	1 a
Methyl bromide: chloropicrin	67:33 ratio at 392	3 ab	**67:33 at 196**	1 a	1 a
3 Way – 1,3-D fb chloropicrin fb metam sodium	132 kg/ha + 168 kg/ha + 357 kg/ha	11 b	**Same as LDPE**	7 ab	9 ab

Footnote: Culpepper 2006. fb means followed by or a sequential treatment.
Purple Nutsedge (*Cyperus rotundus*) plants in 1 bed 25 feet long.

TABLE C 10. PEPPER FRUIT WEIGHT PER PLOT COMPARED TO METHYL BROMIDE TREATMENT UNDER LDPE. FALL 2006. SIX HARVESTS

Treatment	Rate (kg/ha) Under LDPE	Low Density Polyethylene Film (LDPE)	Rate (kg/ha) Under MS and VIF	Metalized Film (MS)	Virtually Impermeable Film (VIF)
Film Color		**White on black**		**Silver on black**	**Grey on black**
Untreated	0	54% f	**0**	75% de	29% g
Iodomethane: chloropicrin	50:50 ratio at 392	83% cd	**50:50 at 196**	105% ab	64% ed
Methyl bromide: chloropicrin	67:33 ratio at 392	100% ab	**67:33 at 196**	105% ab	67% def
3 Way – 1,3-D fb chloropicrin fb metam sodium	132 kg/ha + 168 kg/ha + 357 kg/ha	94% bc	**Same as LDPE**	106% ab	69% def
Soil Temperature		41 C		37 C	44 C

Footnote: Culpepper 2006. fb means followed by or a sequential treatment.
Plots are 1 bed 25 feet long.

TABLE C 11. FILM TYPE AND SOIL TEMPERATURE INFLUENCE PEPPER FRUIT WEIGHT PER PLOT HARVEST 1 AND 2. SPRING 2006.

Treatment	Low Density Polyethylene Film (LDPE)	Metalized Film (MS)
Film Color	**White on black**	**Silver on black**
Pooled over 5 Fumigant Systems	24.0 a	20.5 b
Soil Temperature	30 C	20 C

Footnote: Culpepper 2006. fb means followed by or a sequential treatment.
Plots are 1 bed 25 feet long.

TABLE C 12. NUMBER OF PEPPER FRUIT - METHYL BROMIDE:CHLOROPICRIN VERSUS THREE WAY COMBINATION. SPRING 2006

Fruit Size	Methyl Bromide : Chloropicrin (# of Fruit)	3 Way Mix 1,3-D fb chlorpicrin fb metam Na
Jumbo	30 b	125 a
X-Large	219 a	237 a
Large	153 a	143 a
Chopper	217 a	252 a
Cull	11 a	9 a
Jumbo + X-Large + Large	402 b	505 a

Footnote: Culpepper 2006. fb means followed by or a sequential treatment.
Plots are 3 rows by 100 feet long.

CALIFORNIA REGION

Laboratory work (Prince and Sidhu, 2005) looked at fungicide resistance of *Phytophthora capsici*. The isolates that show the highest degrees of resistance to metalxyl were collected from the field in California. Metalxyl sensitivity in *P. capsici* ranged from highly sensitive (e.g. PPC6 which didn't grow or sporulate in the presence of metalaxyl) to highly resistant (PPc2 which grew and produced spores in metalaxyl at the highest concentration tested). Studies were also conducted on the fungicides famoxate and cyazofamide, neither of which were very good at inhibiting fungal mycelial growth, but cyazofamide was highly effective at preventing sporulation. The authors indicate that the studies need to be repeated with more isolates and more fungicides.

TABLE C 13. YIELD LOSS DUE TO PHYTOPHTHORA CAPSICI ROOT ROT, RED BELL PEPPER YIELD LOSS, DEARDORFF JACKSON FARMS, VENTURA CA 2005

Treatment	Yield (tons)	Field Size (acre)	Value per ton ($)	Estimated Crop Value ($)
Fumigated	26	35	240	$ 218,400
Non-fumigated	12.8	35	206	$ 92,480
Change	49 %	No change	86 %	42 %

Footnote: Non-fumigated field had a lower value because of fewer mature red peppers. CA Pepper Attachment 2. Prince and Sidhu 2005.

Two greenhouse studies were conducted for the California Pepper Commission (Matherson, 2005) were initiated in Arizona to look at control of *Phytophthora capsici* through the use of unregistered fungicides. In both studies all of the untreated pepper plants were dead within 5 to 13 days of being transplanted into *P. capsici* infested soil. The plants treated with cyazofamide, or fenamidone plus propamocarb provided plant root and shoot fresh weights similar to sterilized soil. The results of these trials suggest that several fungicides currently not registered for use on peppers may be effective components of a management program for Phytophtora root and crown rot. However, these studies did not look at pepper fruit weight and will need to be conducted under field conditions to verify the effectiveness of these treatments.

Researchers in Cornell (Jahn, 2004) conducted research funded by the California Pepper Commission from 2001 through 2004 to breed pepper plants that are resistant to *Phytophthora capsici*. There work has established that it may be possible to breed Phytophthora resistance into pepper plants that already have crown blight and root rot tolerance.

In 1999 researchers in California conducted six weed control trials (Smith and Mullen 1999). The standard combination of napropamide plus bensulide was compared to s-metolachlor, halosulfuron, and rimsulfuron. S-metolachlor (1.27 to 1.59 lb ai/acre) provided good control of nightshade, shepherdspurse, sow thistle, and yellow nutsedge. Halosulfuron (0.031 to 0.062 lb ai/acre) provided good weed control but was phytotoxic to peppers in all trials in which it was tested.

Furthermore, a number of important caveats must be mentioned when considering these results:

(1) Plots used were quite small, and it is not at all clear if the promising results will hold reliably in larger commercial fields. This is particularly worrisome given the highly variable results reported by other researchers for the same methyl bromide alternatives.

(2) The nutsedge populations in this study were dominated by yellow nutsedge (90 % of the total number). It is not clear if populations where purple nutsedge is dominant will be controlled as effectively. A number of other studies have indicated that purple nutsedge is a hardier species, and even in Culpepper and Langston's study, it appeared more resistant to the methyl bromide alternatives. For example, methyl iodide gave "77 % control" of yellow nutsedge, but only "37 % control" of purple nutsedge. Control in this case was apparently defined as the reduction in nutsedge populations as compared to populations in the untreated control.

(3) This study was done only with watermelons, and it is not clear if other cucurbits will respond so favorably in terms of yield, or lack of phytotoxic response. Also, a custom-

built applicator had to be used for the metam-sodium applications to eliminate worker exposure risks, according to the authors. It is not yet clear if such an applicator can be mass-produced and/or used reliably in a commercial setting.

Another recent study of methyl bromide alternatives involving key weed pests was done by Gilreath et al. 2005 also (Crop Prot (24): 903-908. One of 3 trials in that study showed an average of 30 % lower bell pepper yields with nutsedges and nematodes as the key pests present. In the other 2 trials yields were not significantly different across different fumigant treatments, but nutsedge pressure was lower in those trials as compared to the third. Important caveats to these results are - this was a small-plot study and was done in Florida. Thus it is not clear how applicable the results are to the more northern regions requesting methyl bromide for vegetable crops (e.g., Virginia, Maryland).

16. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT THAT THE PARTY IS AWARE OF WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE

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 methyl iodide, 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.

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.

Methyl iodide: ONLY has an 'experimental use permit' that allows field trials on about 200 acres (combined) of several crops (none of which are cucurbits). Under development for future registration submission

Propargyl bromide: Under proprietary development for future registration submission.

Sodium azide: Under proprietary development for future registration submission.

Furfural: registered for greenhouse ornamentals only. It is under proprietary development for other registration submissions.

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

***Muscadore albus* Strain QST 20799**: Registered but not yet for available in the U.S. Currently, no commercial formulation is available for testing or sale.

17. (i) ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WITHOUT METHYL BROMIDE?

No. Areas where methyl bromide is not used in this region do not face moderate to severe populations of the key pests.

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

Peppers are grown in fields. It is currently neither technically feasible nor economically viable to grow peppers in soil-less culture or in containers.

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

Soilless systems are not currently technically or economically feasible for open field US Pepper production.

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.

(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.

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 MINIMISE METHYL BROMIDE USE AND EMISSIONS IN THE PARTICULAR USE

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 some growers use HDPE tarps.	Growers have switched from a 98% MeBr formulation to a 67 % formulation. Between 1997 and 2001, the U.S. has achieved a 36 % reduction in use rates.	From 2 % to 33 %	Not feasible because fumigant would not be located in the area of heavy pest pressure.	No
WHAT FURTHER USE/EMISSION REDUCTION STEPS WILL BE TAKEN FOR THE METHYL BROMIDE USED FOR CRITICAL USES?	Research is underway to develop use in commercial production systems	Research is underway to develop use of a 50 % methyl bromide formulation in Michigan commercial production systems. Not known if other regions are planning similar work.	Research is underway to develop use of a 50 % methyl bromide formulation in Michigan commercial production systems. Not known if other regions are planning similar work.	Not feasible.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try less frequent applications.

OTHER MEASURES (PLEASE DESCRIBE)	Examination of promising but presently unregistered alternative fumigants and herbicides, alone or in combination with non-chemical methods, is planned in all regions (Please see Section 17 for each region for details)	Measures adopted in Michigan will likely be used in the other regions when fungi are the only key pests involved	Measures adopted in Michigan will likely be used in the other regions when fungi are the only key pests involved		Unknown

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.

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 that are trained at handling these hazardous pesticides. In practice, this means that methyl bromide is applied by a limited number of very experienced applicators with the knowledge and expertise to minimize dosage to the lowest level possible to achieve the needed results. In keeping with both local requirements to avoid "drift" of methyl bromide into inhabited areas, as well as to preserve methyl bromide and keep related emissions to the lowest level possible, methyl bromide application for tomatoes is most often machine injected into soil to specific depths.

As methyl bromide has become 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 above.

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.

Economic data for the 2006 methyl bromide critical use renomination were taken from applications for methyl bromide critical use and were updated from previous nominations when newer information was available. The following economic assessment is organized by methyl bromide critical use application. Expected impacts when using methyl bromide alternatives are given in tables E1 through E4.

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

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

TABLE E 1. CALIFORNIA: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	787	739
* PRICE PER UNIT (US$)	$27	$27
= GROSS REVENUE PER HECTARE (US$)	$21,344	$20,063
- OPERATING COSTS PER HECTARE (US$)	$17,246	$17,160
= NET REVENUE PER HECTARE (US$)	$4,098	$2,903
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,194
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$8
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	6%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	29%
5. PROFIT MARGIN (%)	19%	14%

TABLE E 2. FLORIDA: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

FLORIDA PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	2,445	1,736	1,369
* PRICE PER UNIT (US$)	$11	$11	$11
= GROSS REVENUE PER HECTARE (US$)	$27,609	$19,602	$15,461
- OPERATING COSTS PER HECTARE (US$)	$20,856	$21,874	$21,874
= NET REVENUE PER HECTARE (US$)	$6,753	$(2,272)	$(6,413)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$9,025	$13,166
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$60	$88
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	33%	48%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	134%	195%
5. PROFIT MARGIN (%)	24%	-12%	-41%

TABLE E 3. GEORGIA : ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

GEORGIA PEPPER (DOUBLE CROPPED)	METHYL BROMIDE	1, 3-D + CHLOROPICRIN	METAM-SODIUM
vYIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	4,726	3,355	2,646
* PRICE PER UNIT (US$)	$11	$11	$11
= GROSS REVENUE PER HECTARE (US$)	$52,198	$37,060	$29,231
- OPERATING COSTS PER HECTARE (US$)	$40,463	$34,961.76	$31,760
= NET REVENUE PER HECTARE (US$)	$11,734	$2,099	$(2,530)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$9,635	$14,264
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$64	$95
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	18%	27%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	82%	122%
5. PROFIT MARGIN (%)	22%	6%	-9%

TABLE E 4. MICHIGAN: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

MICHIGAN PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	4,510	4,239
* PRICE PER UNIT (US$)	$7	$6
= GROSS REVENUE PER HECTARE (US$)	$31,567.68	$27,448
- OPERATING COSTS PER HECTARE (US$)	$30,962.28	$28,657
= NET REVENUE PER HECTARE (US$)	$605	$(1,209)
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,815
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$15
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	6%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	300%
5. PROFIT MARGIN (%)	2%	-4%

TABLE E 5. SOUTHEASTERN USA (EXCEPT GEORGIA): ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEASTERN USA (EXCEPT GEORGIA) PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	2,965	2,105	1,661
* PRICE PER UNIT (US$)	$7	$7	$7
= GROSS REVENUE PER HECTARE (US$)	$19,867	$14,106	$11,126
- OPERATING COSTS PER HECTARE (US$)	$15,869	$13,616	$12,357
= NET REVENUE PER HECTARE (US$)	$3,998	$490	$(1,231)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$3,508	$5,230
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$23	$35
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	18%	26%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	88%	131%
5. PROFIT MARGIN (%)	20%	3%	-11%

Summary of Economic Feasibility

There are currently few alternatives to methyl bromide for use in peppers, and there are factors that limit existing alternatives' usability and efficacy. These include pest complex, climate, and regulatory restrictions. As described above, the two most promising alternatives to methyl bromide in Florida, Georgia, and the Southeastern USA for control of nut-sedge in peppers (1,3-D + chloropicrin and metam-sodium) are considered not technically feasible. This derives from regulatory restrictions and the magnitude of expected yield losses when they are used. Economic data representing the Florida, Georgia, and Southeastern USA pepper growing conditions are included in this section as a supplement to the biological review to illustrate the impacts of using methyl bromide alternatives, not to gauge them with respect to economic feasibility. However, in California and Michigan 1,3-D + chloropicrin is considered technically feasible. Economic growing conditions are presented below to illustrate the economic feasibility of using methyl bromide alternatives.

CALIFORNIA

California pepper producers will experience estimated yield losses of 6%. There are no marketing delays associated with the use of 1,3-D + chloropicrin.

MICHIGAN

The US concludes that, at present, no economically feasible alternatives to methyl bromide exist for use in Michigan pepper production. Two factors have proven most important in this conclusion. These are yield loss and missed market windows, which are discussed individually below.

1. YIELD LOSS
Expected yield losses of 6% are anticipated throughout Michigan pepper production.

2. MISSED MARKET WINDOWS
The US agrees with Michigan's assertion that growers will likely receive significantly lower prices for their produce if they switch to 1,3-D + chloropicrin. This is due to changes in the harvest schedule caused by the above described soil temperature complications and extended plant back intervals when using 1,3-D + chloropicrin.

The analysis of this effect is based on the fact that prices farmers receive for their peppers vary widely over the course of the growing season. Driving these fluctuations are the forces of supply and demand. Early in the growing season, when relatively few peppers are harvested, the supply is at is lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, pepper growers manage their production systems with the goal of harvesting the largest possible quantity of peppers when the prices are high. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of pepper operations.

To describe these conditions in Michigan pepper production, weekly pepper sales data from the US Department of Agriculture for the previous three years was used to gauge the impact of early season price fluctuations on gross revenues. Though data availability is limiting, it is assumed that if pepper growers adjust the timing of their production system, as required when using 1,3-D + Chloropicrin, that they will, over the course of the growing season, receive gross revenues reduced by approximately 7.5%. The season average price used in our analysis of the economic feasibility of the alternatives was reduced by 7.5% to reflect this. Based on currently available information, the US believes this reduction in gross revenues serves as a reasonable indicator of the typical effect of planting delays resulting when methyl bromide alternatives are used in Michigan pepper production.

FLORIDA
No technically (and thus economically) feasible alternatives to methyl bromide are presently available for Florida pepper growers. As such, the US concludes that use of methyl bromide is critical in Florida pepper production.

GEORGIA
No technically (and thus economically) feasible alternatives to methyl bromide are presently available to Georgia pepper growers. As such, the US concludes that use of methyl bromide is critical in Georgia pepper production. Note that data describing Georgia pepper production is representative of a double cropped production system.

SOUTHEASTERN USA EXCEPT GEORGIA
No technically (and thus economically) feasible alternatives to methyl bromide are presently available for the effected Southeastern USA pepper growers. As such, the US concludes that use of methyl bromide is critical in Southeastern USA pepper production.

Part F: NATIONAL MANAGEMENT STRATEGY FOR PHASE-OUT OF THIS NOMINATED CRITICAL USE
Renomination Form Part B: 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

(i) DESCRIPTION AND IMPLEMENTATION STATUS:

See answer to Question 15 above. Many research projects are ongoing and considerable funding is being used in this effort.

(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 answer to Question 15 above.

(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 previous item above.

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

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

(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.

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

2008 Methyl Bromide Usage Newer Numerical Index - BUNNIE									Peppers	
December 18, 2006		Region		Southeast Pepper	Georgia Pepper	Florida Pepper	Michigan Pepper	California Pepper	Sector Total or Average	Notes
Other Considerations	Marginal Strategy Among Best Strategies & Economic Analysis (See Chapter)	Possible Regime		Telone+Pic, Metam-Sodium	Telone+Pic, Metam-Sodium	Telone+Pic, Metam-Sodium	Telone + Pic	Telone + Pic		
		Loss Estimate (%) - Yield (Y), Quality (Q), Market Window (M), Time (T)		29%	29%	29%	22% - 6%(Y) + 16%(T)	6%		
		Loss per Hectare (US$/ha)		$ 8,954	$ 7,368	$ 6,724	$ 933	$ 1,194		
		Loss per Kg of MeBr (US$/kg)		$ 60	$ 49	$ 45	$ 19	$ 8		
		Loss as a % of Gross Revenue		29%	21%	23%	4%	6%		
		Loss as a % of Net Op Revenue		76%	112%	73%	100%	29%		
	Dichotomous Variables (Y/N)	Strip or Bed Treatment?		Strip	Strip	Strip	Strip	Flat		
		Currently Use Alternatives?		Yes	Yes	Yes	Yes	Yes		
		Tarps / Deep Injection Used?		Tarp	Tarp	Tarp	Tarp			
	Other Issues	Frequency of Treatment (x/ yr)		1x per year	1x per year	1x per year	1x per year	1x per year		
		Change in CUE Request		decrease	same	decrease	increase	decrease	decrease	
Most Likely Combined Impacts (%)		Florida Telone Restrictions	%	0%	8%	68%	0%	0%		
		100 ft Buffer Zones	%	0%	0%	1%	0%	0%		
		Key Pest Distribution	%	58%	58%	58%	75%	41%		
		Regulatory Issues	%	0%	0%	0%	0%	20%		
		Unsuitable Terrain	%	0%	0%	0%	0%	0%		
		Cold Soil Temperature	%	0%	0%	0%	75%	0%		
		Total Combined Impacts	**%**	**58%**	**61%**	**86%**	94%	52%		
Most Likely Baseline Transition		(%) Able to Transition		42%	42%	42%	0%	75%		
		Minimum # of Years Required		7	7	7	0	5		
		(%) Able to Transition / Year		**6%**	**6%**	**6%**	**0%**	**15%**		
Joint Adjusted Use Rate			kg/ha	**188**	**188**	**186**	**175**	**165**		*
Joint Adjusted Dosage Rate			g/m2	18.8	18.8	18.6	17.5	16.5		
2009 US CUE Application Information	Pounds	*Amount - Pounds*		*572,850*	*765,408*	*2,766,400*	*41,500*	*80,000*	*4,226,158*	
		Area - Acres		*4,450*	*5,712*	*20,250*	*389*	*500*	*31,301*	
		Rate (lb/A)		*128.73*	*134.00*	*133.00*	*106.68*	*160.00*	*135*	
	Metric	**Amount - Kilograms**		**259,840**	**347,183**	**1,254,817**	**18,824**	**36,287**	**1,916,951**	
		Treated Area - Hectares		1,801	2,312	8,195	157	202	12,667	
		Rate (kg/ha)		144	150	153	120	179	151	
EPA Preliminary Value			**kgs**	**210,911**	**347,183**	**1,230,822**	**15,195**	**36,287**	**1,840,399**	
EPA Baseline Adjusted Value has been adjusted for:				Double Counting, Growth, EPA Use Rate Adjustment, Joint Use Rate Adjustment, and Combined Impacts						*
EPA Baseline Adjusted Value			kgs	80,889	150,753	745,107	12,092	17,272	1,006,114	*
EPA Transition Amount			kgs	(16,105)	(35,954)	(170,486)	-	(2,591)	(225,137)	*
EPA Amount of All Adjustments			kgs	**(146,128)**	**(232,384)**	**(656,201)**	**(3,103)**	**(21,606)**	**(1,059,422)**	
Most Likely Impact Value for Treated Area			**kgs**	**64,784**	**114,799**	**574,621**	**12,092**	**14,681**	**780,977**	*
			ha	**370**	**656**	**3,284**	**69**	**98**	**4,477**	
			Rate	**175**	**175**	**175**	**175**	**150**	**174**	*
Sector Research Amount (kgs)				**2,844**	**2009 Total US Sector Nomination**			**783,821**		*

1 Pound = 0.453592 kgs 1 Acre = 0.404686 ha

APPENDIX B FLORIDA TELONE® (1,3-D) REGULATORY RESTRICTIONS

BACKGROUND

Telone® (1,3-dichloropropene or 1,3-D) is a restricted use pesticide which is available for use by Florida fruit and vegetable growers through a special local need (SLN) registration. This registration includes specific use restrictions for certain Florida counties. In these counties, Telone® can only be used on soils having restrictive layers to downward water movement that support seepage irrigation. This is in addition to nationwide use restrictions that state that Telone® cannot be used within 100 feet of wells used for potable water or karst topographic features.

This document estimates the area in key Florida agricultural counties that cannot use Telone® based on karst and soil restrictions. The data sources and methods used to make these estimates are described below. Telone® use restrictions are an important consideration because Telone® is a potential replacement for methyl bromide. The agricultural counties considered in this analysis grow crops that have submitted methyl bromide critical use exemptions (CUE). These counties correspond to the counties listed as having additional use restrictions on the Telone® SLN label. Estimating the area not suitable for Telone® use is part of the analysis conducted by the United States to determine the amount of methyl bromide that has a critical need in Florida. Fumigation with 1,3-D is an alternative to fumigation with methyl bromide, and one that results in smaller yield loss differences with methyl bromide than some of the other alternatives.

CROP INFORMATION

Methyl bromide CUEs for 2008 were submitted for several field grown specialty crops grown in Florida, including strawberry, tomato, pepper, and eggplant. This analysis focuses on these crops because Telone® is a potential alternative to methyl bromide on these crops. County level acreage for these four crops was obtained from the Census of Agriculture (USDA, 2002). Table 1 presents the major producing counties in terms of harvested acres for each crop. Figure 1 illustrates the distribution of harvested acres for each crop by each county. Figure 2 is a map of Florida counties and also indicates which counties are the major producers of these four crops. The highlighted counties account for a significant portion, generally 90% or more, of the crops' acreages and were therefore selected for this analysis.

KARST RESTRICTION

Telone® is a restricted use pesticide that cannot be used within 100 feet of karst topological features. Soil physiographic divisions in Florida having karst characteristics were used to identify karst topography in Florida. Definitions of the physiographic divisions were obtained from Brooks (1981). These physiographic divisions are associated to the Physiographic Divisions Map of Florida. The Physiographic Divisions Map of Florida, originally created by Brooks (1981), was converted to a digital format by the United States Geologic Service (USGS) et al. (2000). It is a general reference map of Florida physiographic divisions (districts, subdistricts, subdivisions) defined by Brooks (1981). USG used this map in a geographic information system (GIS) to estimate the area within each county having karst features (Apendix Table 1 and Appendix Figure 3).

Soil physiographic division characteristics used to estimate locations of karst topography may not define all karst features in Flordia due to the scale and uncertainties associated with the conversion of the map into a digital format. The scale issue means that small units of karst topographical features may not be included in the physiographic divisions map, thus the proportion of land area affected by karst features is likely to be under- rather than over-estimated. Because this map was produced before GIS mapping tools were available, it was not designed for GIS use. It was converted to digital format but when overlaid on newer and more accurate GIS maps of Florida, its land area differs by approximately 3%, although not every aspect differs by this amount. The physiographic divisions map is, however, the best available information on the physiographic divisions of Florida. Currently, USG is unable to account for the magnitude of the variability associated with this map. Therefore, Table Appendix B 1 provides our best estimates of the areas in Florida with karst topographical features.

SPECIAL LOCAL NEED RESTRICTION

In addition to the Telone® use restriction related to karst topography, certain Florida counties[1] have additional soil restrictions as stated on the Telone® supplemental label. Telone® can only be used on soils having restrictive layers to downward water movement that can support seepage irrigation in specified counties. Most strawberry, tomato, pepper, and eggplant are grown in counties that have this restrictive soil layer.

Soils potentially having these restrictive layers, such as argillic or spodic horizons, are of the following taxonomic soil orders: Alfisol, Ultisol, Mollisol, and Spodosol. Electronic soil survey data for each county were downloaded from the Soil Data Mart maintained by the USDA Natural Resource Conservation Service (NRCS). County soil surveys delineate soil map units containing multiple soil types. For this analysis, the map units containing at least 50 percent of the required soils were identified as locations that meet the label requirements. The remaining map units were considered to contain soils unsuitable for Telone® use.

Electronic soil survey data were used to quantify the area within each county not suitable for Telone® use based on the soil criteria of the Florida Special Local Need (SLN) registration. Tabular data of soil surveys for each county were used as follows. First, soils series (components of soil map units) that have at least one of the four above mentioned soil orders were identified using the "Taxonomic Classification of Soils" table of the soil survey. This step identified the soil series potentially having the required restrictive layers. Second, soil map units were selected in the "Component Legend" table of the soil survey if they contained the identified soil series. The "Component Legend" table provides the percentage of each soil component in a map unit. If at least 50 percent of the map unit contains the identified soils, soils meeting the SLN restriction, then those map units were selected. Next, the "Acreage and Proportionate Extent of Soils" table of the soil survey was used to calculate the total acreage of the suitable

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[1] These counties include Brevard, Broward, Charlotte, Citrus, Collier, Dade, De Soto, Glades, Hardee, Hendry, Hernando, Highlands, Hillsborough, Indian River, Lake, Lee, Manatee, Martin, Monroe, Okeechobee, Orange, Osceola, Palm Beach, Pasco, Pinellas, Polk, St. Lucie, Sarasota, Seminole, Sumter, and Volusia

map units in a county. Finally, the area not represented by these suitable soils was calculated to estimate the area not suitable for Telone® use. The areas not meeting the SLN soil requirements are presented in Table 1.

CALCULATING THE AREA OF TELONE® RESTRICTION

The areas deemed unsuitable for Telone® use due to soil restrictions may not be additive to the karst areas because locations of restricted soils and karst topography may overlap. Further spatial analysis is required to determine the total area in a county not suitable for Telone® use. In using the available information to estimate areas, therefore, USG used two assumptions: the most restrictive (in the sense of allowing the greatest use of Telone®) is that areas of karst and areas where seepage irrigation is not feasible overlap to the greatest extent possible[2]; and the less restrictive, standard statistical assumption, that both areas of karst and areas lacking a restrictive layer (areas where seepage irrigation are not feasible) are identically and independently distributed[3].

The assumption that would have resulted in the lowest level of allowable Telone® use, that the areas of karst topography and the areas where seepage irrigation is not feasible are mutually exclusive, was not used to derive estimates for the purposes of these analyses.[4]

In all instances the agricultural areas were assumed to be identically and independently distributed across soil types within the county. To make any other assumption would require a survey of each county where any one of these crops is grown. Further, growers do move areas of cultivation and also rotate crops as a means of maintaining lower pest pressures so that from year to year the results may change.

CONCLUSION

It is important to note that soil orders are the broadest class in the soil taxonomic system. Therefore, this analysis aims to identify soils that potentially have the required restrictive layers. This leads to an underestimate rather than an overestimate of areas where seepage irrigation is not feasible. Further investigation such as onsite field testing and more detailed soil survey analysis may be required to more accurately determine if a soil is suitable for Telone® use. However, USG believes this analysis provides a more quantitative understanding of Telone® use restrictions in Florida than that previously used in the methyl bromide CUE process.

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[2] In other words, if 20% of a county has karst topographical features and 30% lacks a restrictive layer so that seepage irrigation is not feasible, a total of 30%, the larger of the two numbers, of the county area cannot use telone®.

[3] Using the assumption of identical and independently distributed soil features, a county that had 20% of its area with karst topographical features and 30% lacking a restrictive layer, the total county area that could not use Telone® would be 44%, 30% and 20% of the remaining 70%.

[4] Using the assumption that the two restrictions are mutually exclusive, and in using the example of 20% karst and 30% lacking a restrictive layer, Telone® use would not be allowed in 50% of the are of the county.

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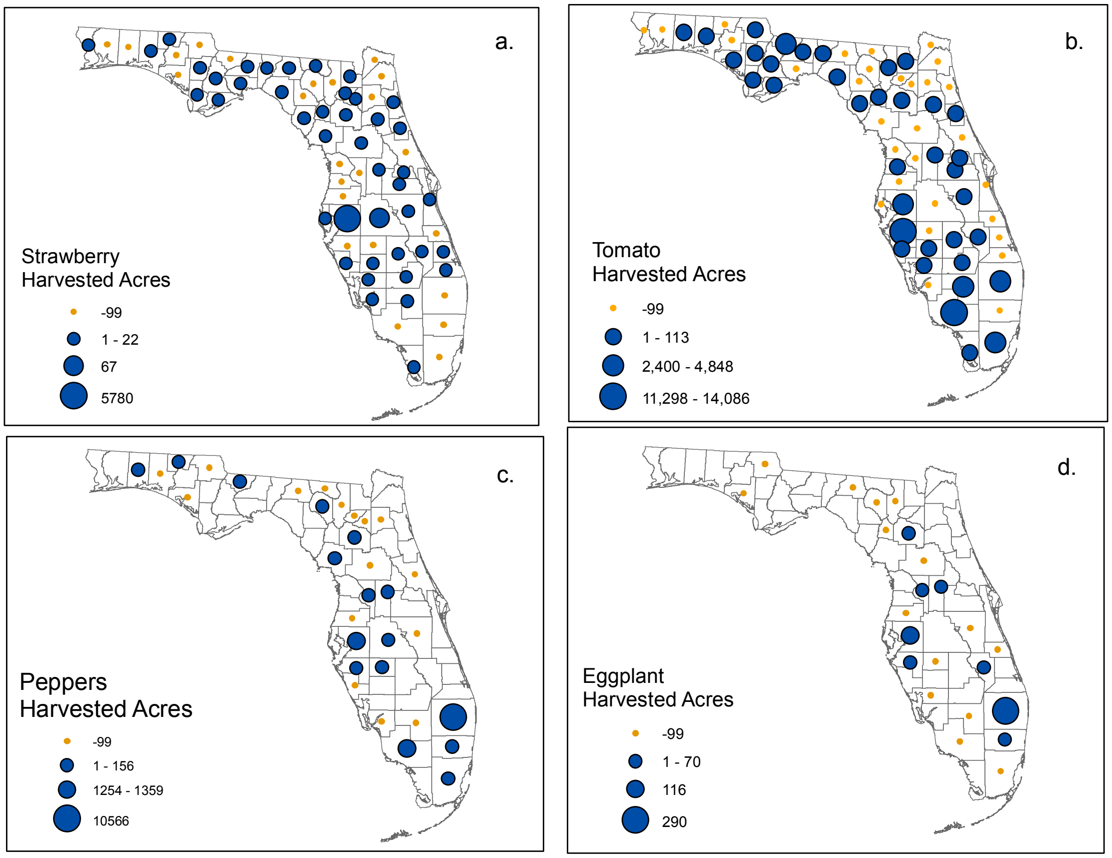
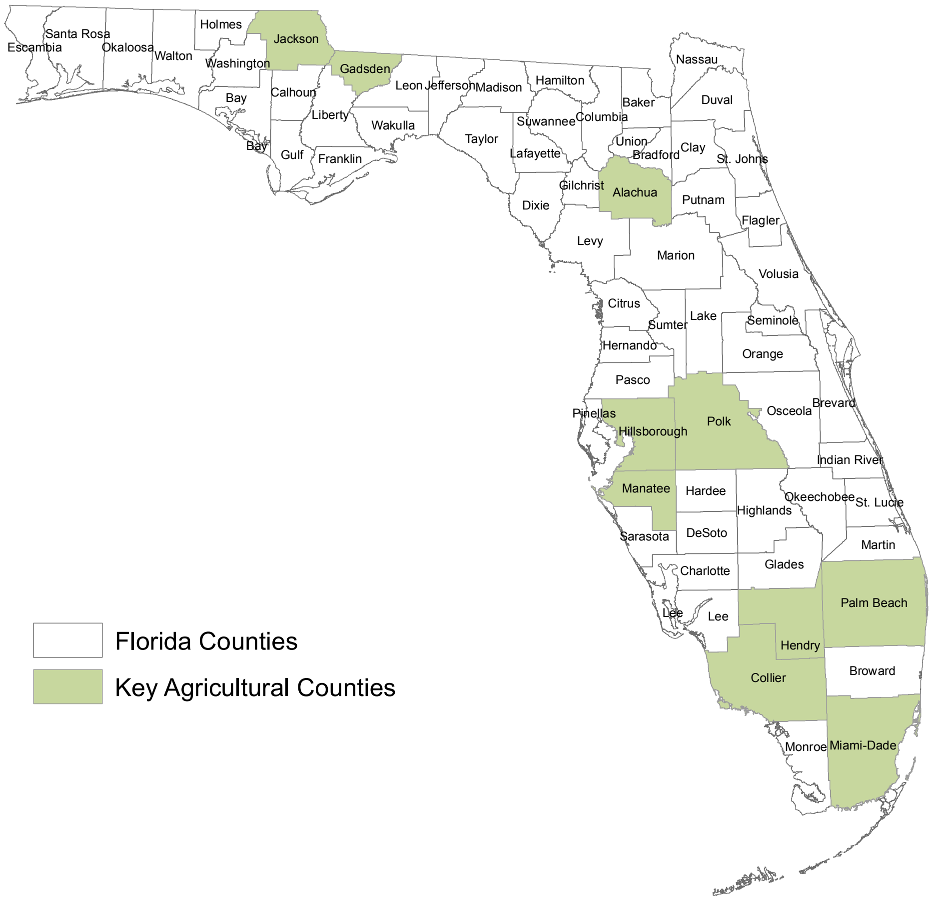
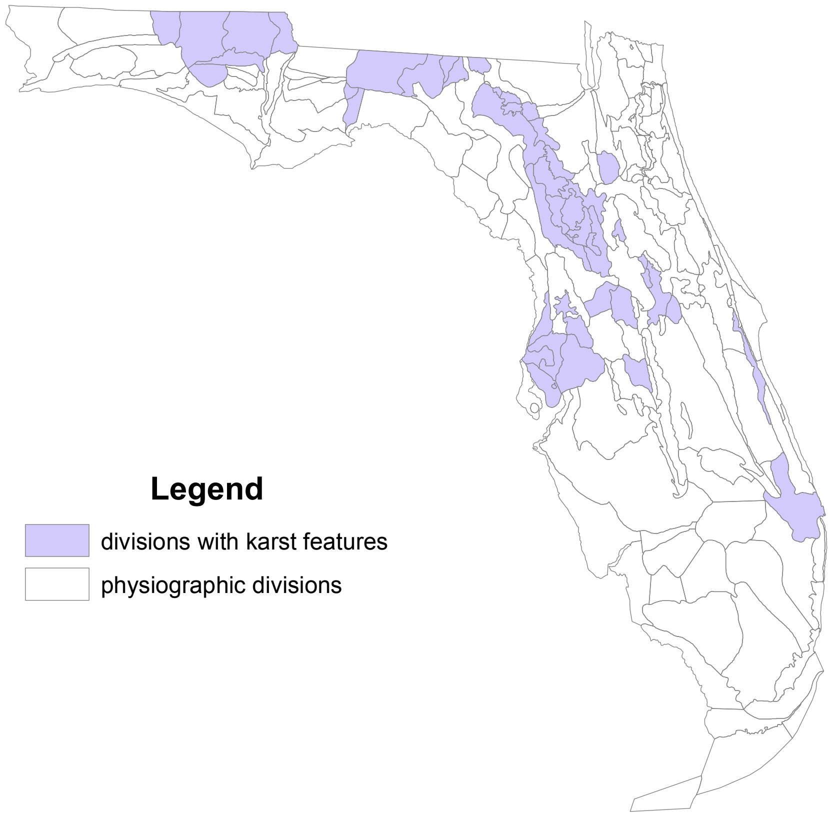


Appendix B Figure 1. Acres Harvested for strawberry (a), tomatoes (b), pepper (c), and eggplant (d) in Florida. Data are from USDA Census of Agriculture, 2002. A county where a crop is grown but acreage is not reported is represented by -99. Florida map obtained from ESRI (2005).



Appendix B Figure 2. Map of Florida counties. The highlighted **counties were selected for this analysis because these counties grow the bulk (generally 90% or more)of tomato, strawberry, pepper, and eggplant crops. Florida map obtained from ESRI (2005).**



Appendix B Figure 3. The Karst Area of Florida. The karst area is an estimate based on selected map divisions described to have karst feature in the Physiographic Divisions Map of Florida. The Physiographic Divisions Map of FL is a generalized map created by the USGS, University of Florida Institute of Food and Agricultural Sciences, and the St Johns River Water management District in 2000.

Appendix B Table 1. Major producing Florida counties in terms of acres harvested for strawberry, tomato, pepper, and eggplant, The areas in each county that are unsuitable for Telone® use based on soil and karst restrictions.

a. Strawberry

County[1]	Acres Harvested[2]	Karst Area[3] in County (%)	SLN Restriction of Unsuitable Soils[4] (%)
Hillsborough	5,780	50	35
Polk	67	9	55
Alachua	22	62	100*

b. Tomato

County[1]	Acres Harvested[2]	Karst Area[3] in County (%)	SLN Restriction of Unsuitable Soils[4] (%)
Collier	14,086	0	32
Manatee	11,298	0	23
Hillsborough	4,848	50	35
Hendry	4,805	0	27
Palm Beach	3,308	17	73
Miami-Dade	2,932	NA*	NA*
Gadsden	2,400	<1	100*
Jackson	113	93	100*

c. Pepper

County[1]	Acres Harvested[2]	Karst Area[3] in County (%)	SLN Restriction of Unsuitable Soils[4] (%)
Palm Beach	10,566	17	73
Hillsborough	1,359	50	35
Collier	1,254	0	32
Manatee	156	0	23

d. Eggplant

County[1]	Acres Harvested[2]	Karst Area[3] in County (%)	SLN Restriction of Unsuitable Soils[4] (%)
Palm Beach	290	17	73
Hillsborough	116	50	35
Manatee	70	0	23

1. Counties included in tables account for at least 80% of the acres harvested for each crop. The remaining acreage is scattered across other counties and no single county accounts for a significant portion.
2. Acres Harvested data are from USDA Census of Agriculture, 2002.
3. The percent Karst Area is an estimate based on selected map divisions described to have karst feature in the physiographic divisions map of Florida. The physiographic divisions map of FL is a generalized map created by the USGS, University of Florida Institute of Food and Agricultural Sciences, and the St Johns River Water management District in 2000.
4. County area based on soils not capable of supporting seepage irrigation as mandated by the SLN or special local need registration.

* Florida state agricultural experts informed US EPA that seepage irrigation is not used in the Northern Florida counties (S. Olson, personal communication via C. Augustyniak, Nov/Dec 2006). Additionally, Telone® cannot be used in Miami-Dade County and therefore, the karst and SLN area analyses were not conducted for this county (E. McAvoy, personal communication via C. Augustyniak, Nov/Dec, 2006).