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

EXECUTIVE SUMMARY

This renomination covers cucurbits of several types (squash, melons, and/or cucumber) grown in the southeastern US (except Florida), Maryland, Delaware, and Michigan. These crops generally are grown in open fields on plastic tarps, often followed by various other crops. Harvest is destined for the fresh market.

Only areas that cannot use alternative fumigants or non-fumigant options, and that face moderate to severe infestations of key pests, have been included in the calculation of nominated amounts and area to be treated. The applicants' requests have also been adjusted downward to account for the lower methyl bromide dose rates (see BUNNIE in Appendix A) for the southern regions of US cucurbit production, since increased use of high barrier films in conjunction with lower rates has been reported there. For Michigan and the mid-Atlantic regions, the low dose rates requested by the applicants were incorporated into calculations.

In developing this renomination the USG examined several recent studies to determine whether yield losses and market window losses associated with the best available fumigant alternative could be altered from previous nominations. Unfortunately none of the studies located by the USG met the criteria that earlier cited studies did. These criteria include: the use of fumigant alternatives registered for the crop nominated, the presence of both a methyl bromide standard and an untreated control as treatments as well as the monitoring of yields under each treatment. Several such studies included a methyl bromide treatment or an untreated control but not both, or included both but did not monitor yield, or included unregistered alternatives. However, research conducted at the University of Georgia that examined use of a three way combination of alternative fumigants (1,3 D followed by chloropicrin followed by metam-sodium) did meet these criteria, Therefore, southern US areas were adjusted to reflect the technical feasibility of this three way combination of alternative fumigants under VIF or metallized films, as a replacement for spring-time applications of methyl bromide+chloropicrin, after accounting for areas in the south that face prohibition of 1,3 D due to karst topographical features.

Michigan is cold and wet during the early spring thaw, and fall fumigant applications cannot be conducted. In these cold production regions the use of fumigant systems using chloropicrin under VIF has resulted in damage to crops such as cucurbits. Further research will need to focus on additional crops with respect to this off-gassing issue. This potential for plant injury may require a longer off-gassing period, which may be needed to avoid phytotoxicity when using chloropicrin under VIF in cold climates. In cucurbit production additional delay in planting may result in producers missing the early, premium market.

NOMINATING PARTY:

The United States of America

NAME

USA01 CUN10 SOIL _CUCURBITS_ Open Field

BRIEF DESCRIPTIVE TITLE OF NOMINATION:

Methyl Bromide Critical Use Nomination for Preplant Soil Use for CUCURBITS Grown in Open Fields (Submitted in 2008 for 2010 Use Season)

CROP NAME (OPEN FIELD OR PROTECTED):

_CUCURBITS 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 (KILOGRAMS)
2010	340,405

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 and use of high barrier films that could be made by USG biologists and economists. In addition, lower methyl bromide dose rates were used in the calculations of the nomination (see BUNNIE in Appendix A) for the southern regions of US cucurbit production, since increased use of high barrier films in conjunction with lower rates has been reported there. For Michigan and the mid-Atlantic regions, the low dose rates requested by the applicants were incorporated into calculations. Finally, the southern US applicants requests were adjusted to reflect the apparent technical feasibility of a three way combination of alternative fumigants (1,3 D followed by chloropicrin followed by metam-sodium) as a replacement for spring-time applications of methyl bromide+chloropicrin in those areas that do not face prohibition of 1,3 D due to karst topographical features.

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. cucurbit production there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- The efficacy of alternatives may be significantly less effective than methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in cucurbit production.

- Some alternatives may be comparable to methyl bromide as long as key pests occur at low pressure. The U.S. is only nominating a critical use exemption (CUE) for cucurbits where the key pest pressure is moderate to high such as nutsedge in the Southeastern U.S.
- Regulatory constraints prevent use of some chemicals, e.g., 1,3-dichloropropene (1,3-D) use is limited in Florida and Georgia due to the presence of karst topographic features.
- Delays in planting and harvesting result in users missing key market windows, and adversely affect revenues through lower prices. Delays in planting and harvesting: e.g., the plant-back interval for 1, 3-dichloropropene +chloropicrin is two weeks longer than methyl bromide +chloropicrin, and in Michigan an additional delay would occur because soil temperature must be higher to fumigate with alternatives.
- Iodomethane has only a one year registration for the year 2008 and thus availability is unknown for subsequent seasons.
- The cost of iodomethane may be prohibitive given the estimate provided by Klassen (2007) and Culpepper (2007) of approximately $10.00 U.S. per pound.

In Michigan cucurbits, metam sodium/potassium + chloropicrin the best registered alternative for the control of the key target pests. These pests are the soil borne fungi *Phytophthora capsici* and *Fusarium oxysporum,* both of which can easily destroy the entire harvest from affected areas if left uncontrolled. At least one of these pests, *P. capsici*, has recently been shown to occur in irrigation water in Michigan (Gevens and Hausbeck, 2003) and has probably contributed to the spread of this pathogen. Due to widespread pest distribution, virtually all of the cucurbit hectares in Michigan currently use methyl bromide(plus chloropicrin) as a prophylactic control. While metam sodium/potassium + chloropicrin provided some control of fungi in recent small-plot trials with cucurbits in Michigan (Hausbeck and Cortright, 2004), there were yield losses (approximately 6%) relative to the methyl bromide + chloropicrin standard.

It is also not yet clear whether these small-scale results accurately reflect efficacy of methyl bromide alternatives in commercial cucurbit production. Furthermore, regulatory restrictions due to concerns over human exposure and ground water contamination, along with the lower yields, result in potential economic infeasibility of this formulation as a practical methyl bromide alternative. Key among these factors are a delay in planting up to 14 days relative to methyl bromide , due to a combination label restrictions and the low soil temperatures typical of Michigan**,** as well as a mandatory 30 m buffer for treated fields with 1, 3-dichloropropene + chloropicrin near inhabited structures. Delays in planting may result in growers missing key market windows and premium harvest prices, and buffer zones will result in some areas remaining vulnerable to pests in the absence of methyl bromide.

In Maryland and Delaware cucurbits, *Fusarium oxypsorum niveum* exists in 3 separate races, with a fourth race proposed (Zhou and Everts 2007), and no one crop cultivar has resistance to heavy infestations of all races. All acreage requesting methyl bromide is this region has these pathogens present. In particular, the existence of the highly aggressive race 2 of *Fusarium oxysporum niveum* , along with a high concentration of inoculum result in a much higher level of performance requirement for any control options (Zhou and Everts, 2003, 2007).
Crop experts in Maryland report that methyl bromide alternatives provided lower protection against the pathogen while also creating obstacles to meeting premium market windows. USG believes that the situation here is similar to Michigan, in that the best alternatives (1,3 D +

chloropicrin) may offer some defense against the pathogen (with a yield loss similar to that likely in Michigan). However, since the crop acreage involved is in low-lying coastal plain, water-logged soils frequently occur in rainy periods and this could delay fumigation with this and other alternatives (such as metam-sodium) and cause additional losses by forcing growers to miss key mid-July market windows. In addition, yellow nutsedge is a critical pest in Maryland that may occur in high enough populations that it is not adequately controlled without methyl bromide.

In the Southeastern U.S., nutsedges are the primary target pest of concern. Some growers in this region also face root-knot nematodes and the soil-borne fungal pathogens (described above) as key pests. Left uncontrolled, any of these pests could completely destroy the harvests from affected areas. Metam-sodium offers some control of nutsedges and nematodes, while 1, 3-dichloropropene + chloropicrin provides good control of nematodes (e.g., Eger, 2000; Noling et al., 2000). However, in areas where nutsedge infestations are moderate to severe and fungal pathogens are present, metam-sodium results in an estimated 44 % yield loss relative to methyl bromide (Locascio, et al., 1997). In such areas, use of 1, 3-D + chloropicrin is likely to lead to an estimated 29 % yield loss relative to methyl bromide (Locascio, et al., 1997). In addition to these estimated losses, it must be noted that 1, 3-dichloropropene + chloropicrin cannot be used in portions of the southeastern U.S. (primarily Kentucky and Georgia as regards this nomination) due to the presence of karst topographic features. 1, 3-dichloropropene cannot be used on such soil due to label restrictions created in response to concerns over groundwater contamination. Together, these yield losses and regulatory restrictions render these promising methyl bromide alternatives technologically and economically infeasible.

It should be noted also that all studies of yield losses for metam-sodium and 1, 3-dichloropropene + chloropicrin relative to methyl bromide are based on small plot research trials done on non-cucurbit crops. Large-scale on-farm trials will need to be conducted in cucurbits with high fungal and nutsedge pest pressure to determine the long term potential for these alternatives.

Some researchers have also reported that these methyl bromide alternatives are degraded more rapidly in areas where they are applied repeatedly, due to enhanced metabolism by soil microbes. This phenomenon may compromise long-term efficacy of these compounds and appears to need further scientific scrutiny. Neither of these promising methyl bromide alternatives is presently adequate for control of key pests, and methyl bromide remains a critical use for cucurbits in Michigan and in the southern 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.*

NOMINATING PARTY CONTACT DETAILS:

Contact Person:	Hodayah Finman.
Title:	Foreign Affairs Officer
Address:	Office of Environmental Policy U.S. Department of State 2201 C Street, N.W. Room 2658 Washington, D.C. 20520 U.S.A.
Telephone:	(202) 647-1123
Fax:	(202) 647-5947
E-mail:	Finmanhh@state.gov

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

_____________________________ _______________________________ _______________

Signature Name Date

Title: ____

CONTACT OR EXPERT(S) FOR FURTHER TECHNICAL DETAILS:

Contact/Expert Person:	Richard Keigwin
Title:	Division Director
Address:	Biological and Economic Analysis Division Office of Pesticide Programs U.S. Environmental Protection Agency 1200 Pennsylvania Avenue, N.W. Mailcode 7503P Washington, D.C. 20460 U.S.A.
Telephone:	(703) 308-8200
Fax:	(703) 308-7042
E-mail:	Keigwin.Richard@epa.gov

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 CUN10 SOIL _CUCURBITS_ 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 CUN10 SOIL __CUCURBITS_ 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
USA01 CUN10 SOIL _CUCURBITS_ Open Field

2. (Renomination Form 2.) DESCRIPTIVE TITLE OF NOMINATION:
Methyl Bromide Critical Use Nomination for Preplant Soil Use for __Cucurbits_ Grown in Open Fields (Submitted in 2008 for 2010 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)*):

Cucurbits (squash, melons, and/or cucumber) grown in Alabama, Arkansas, Delaware, Georgia, Kentucky, Louisiana, Maryland, Michigan, North Carolina, South Carolina, Tennessee, and Virginia. These crops generally 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 (KILOGRAMS)
2010	340,405

(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.)

Major points include: (1) use of metallised films and VIF to reduce rates of methyl bromide used is now underway in the southeastern regions of the US, although time will be necessary for all growers to transition to this methodology; (2) re-registration of alternative fumigants is underway and label changes may occur that will affect methyl bromide usage in as yet unknown ways. Reductions in dose rates used in BUNNI calculations will reflect the recent use of lower methyl bromide application rates under high barrier films in southeastern US regions.

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. cucurbit production there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- The efficacy of alternatives may be significantly less effective than methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in cucurbit production.
- Some alternatives may be comparable to methyl bromide as long as key pests occur at low pressure. The U.S. is only nominating a critical use exemption (CUE) for cucurbits where the key pest pressure is moderate to high such as nutsedge in the Southeastern U.S.
- Regulatory constraints prevent use of some chemicals, e.g., 1,3-dichloropropene (1, 3-dichloropropene) use is limited in Georgia due to the presence of karst topographical features.
- Delays in planting and harvesting result in users missing key market windows, and adversely affect revenues through lower prices. Delays in planting and harvesting: e.g., in Michigan an additional delay would occur because soil temperature must be higher to fumigate with alternatives.

TABLE A 2: EXECUTIVE SUMMARY*

Region		Michigan Cucurbit	Mardel Cucurbit	Southeast Cucurbit	Georgia - Squash	Georgia - Cucumber	Georgia - Melon	Sector Total
EPA Preliminary Value	kgs	26,592	9,117	753,688	92,874	67,224	245,739	1,195,235
EPA Amount of All Adjustments	kgs	(9,960)	-	(543,737)	(71,657)	(51,874)	(177,602)	(854,830)
Most Likely Impact Value for Treated Area	kgs	16,632	9,117	209,951	21,217	15,350	68,137	340,405
	ha	111	61	1,260	127	93	406	2,058
	Rate	150	150	167	167	165	168	165

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

(ii) STATE WHETHER THE USE IS 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):

Our review of available research on other methyl bromide alternatives discussed by MBTOC for cucurbits suggests that, of registered (i.e., legally available) chemistries only metam sodium and

1,3 D + chloropicrin have shown potential as commercially viable replacement to methyl bromide. Non-chemical alternatives are either unviable for US cucurbits or require more research and commercial development before they can be technically and economically feasible. For some areas in the southeastern US, a 3 way combination of 1,3 D + chloropicrin, followed by chloropicrin alone, followed by metam-sodium, has shown promise against key cucurbit pests in spring season fumigation. The transition rate included in the BUNNIE incorporates an estimate of projected use of this strategy. However, a discussion of the limitations of each of these methyl bromide alternatives is included below to illustrate reasons for continued methyl bromide need by growers as they transition to other pest management approaches.

The recent Federal registration of Iodomethane has not been used to adjust the amount of methyl bromide requested in this CUE. Although iodomethane has been registered at the federal level for the period of October 1, 2007 to October 1, 2008 only certain crops are included in this registration, specifically: Strawberry, Pepper, Tomato, Ornamentals, Nurseries, Trees and Vines.

At present state registrations are in place for 18 states, many of which do not request methyl bromide under the CUE process. These states are: Delaware, Georgia, Kentucky, Louisiana, Maine, Michigan, Mississippi, Missouri, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Utah, and Virginia. Neither Florida not California, the two states that are the major users of methyl bromide have registered iodomethane.

Given the limited crops, the time-limited Federal registration (it is valid for one year only, October 2007 to October 2008), and the lack of State registrations in the major methyl bromide-using States, EPA feels that it is appropriate not to include iodomethane as a methyl bromide substitute at this time.

In addition, several other factors work to limit the adoption of iodomethane as a replacement for methyl bromide in the short run. These range from more extensive regulatory constraints vis a vis methyl bromide to the normal process of technology adoption which is not instantaneous.

Like methyl bromide, iodomethane is a restricted use pesticide. In addition to pesticide applicator training, however, a license to apply iodomethane also requires company-provided training. Once training has been provided, iodomethane application must be under the direct (observed) supervision of these trained personnel. We do not believe that classes can be organized and a sufficient number of individuals trained across registered uses so that large-scale adoption of iodomethane can occur in the short-run.

Iodomethane has other restrictions as well. Unlike the case with methyl bromide, the application area must be surrounded by a scalable buffer that increases in size as the field size and or the application rate increases. The buffer can be as much as 490 feet (150 meters) for a 40 acre (16 hectare) field. There are other restrictions as well. For example iodomethane cannot be used within 0.25 miles (over 400 meters) from a ‘sensitive’ occupied site such as a school or nursing home.

Furthermore, very few growers have experience using iodomethane. They will not have had experience selecting a dose and determining which cultural practices are necessary to obtain the best results for the iodomethane application. This will cause them to be reluctant to subject a significant portion of their crop to the experiment of iodomethane.

Although the company producing iodomethane does market other chemicals, it is the understanding of the USG that the company plans to develop a new distribution network. This network is not yet established and is yet another reason why growers may be reluctant to experiment with iodomethane in 2008.

Taking all of these factors into account, along with the limited time horizon of the registration, EPA believes that the appropriate method for addressing the registration of iodomethane is to reduce that amount of iodomethane allocated in the case that the registration is renewed and to adjust the reductions as other States register this compound.

This is the procedure followed for the 2008 allocation year.

For Michigan pests, metam sodium/potassium + chloropicrin is the only key alternative with efficacy approaching that of methyl bromide. However, it has regulatory restrictions due to human exposure concerns, along with technical limitations, that result in economic infeasibility of this formulation as a practical methyl bromide alternative. Key among these factors are a delay in planting as long as 30 days, due both to label restrictions and low soil temperatures, and a mandatory 30 m buffer for treated fields near inhabited structures.

For Southeastern U.S. and Georgia, metam-sodium and 1, 3 D + chloropicrin are the most promising alternatives for nutsedges and nematodes, respectively, which are the key target pests in these regions. However, where nutsedges are severe, metam-sodium, used alone, is technically and economically infeasible due to planting delays, yield losses and inconsistent efficacy, while 1,3 D + chloropicrin is infeasible in some areas due to (1) its use being prohibited on Karst topographic features, which are widespread in these regions, (2) a 21 day planting delay, and (3) yield losses.

There is also evidence that the pesticidal efficacy of both 1,3 D and metam-sodium declines in areas where it is repeatedly applied, due to enhanced degradation of methyl isothiocyanate by soil microbes (Ou et al., 1995; Verhagen et al., 1996; Dungan and Yates, 2003; Gamliel et al., 2003).

While one study in 2006 showed good efficacy of a combination of 1,3 D + chloropicrin and the herbicides napropamide + halosulfuron or metolachlor + trifloxysulfuron in small plots of Florida tomatoes (Santos et al. 2006), these results are not applicable to cucurbits because neither metolachlor or trifloxysulfuron are registered in the US for cucurbits, and halosulfuron can have phytotoxic effects on cucurbits.

All other potential or available methyl bromide alternatives are also technically infeasible for U.S. cucurbits.

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 TOTAL CROP AREA TREATED WITH METHYL BROMIDE IN 2003 (%)
Michigan	8,620	3%
Southeastern U.S (except Georgia)*	18,858	36%
Georgia	25,204	11%
Maryland and Delaware	Unknown	Unknown
NATIONAL TOTAL:	52,682	19%

.* Includes: Alabama, Arkansas, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, and Virginia

(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 Southeastern U.S. Georgia, and Maryland, areas not treated do not have nutsedges or pathogens naturally present in cucurbit fields. Simple absence of all pests is the only reason these areas are not presently treated with methyl bromide.

- In Delaware and Maryland areas without the existence of several races of *Fusarium oxysporum niveum,* one of which is highly aggressive*,* or high concentration of the pathogen could use some alternatives such as 1,3 D.

- In Michigan, all acreage is treated with methyl bromide due to cool weather conditions and high pest pressure from diseases.

(iii) WOULD IT BE FEASIBLE TO EXPAND THE USE OF THESE METHODS TO COVER AT LEAST PART OF THE CROP THAT HAS REQUESTED USE OF METHYL BROMIDE? WHAT CHANGES WOULD BE NECESSARY TO ENABLE THIS?

The primary reason that some cucurbits may be grown without methyl bromide in all three regions is the absence of both key target pests and constraints to use of alternatives (i.e., absence of nutsedge in the Southeast, and Georgia, several races of *Fusarium* and nutsedges in Delaware and Maryland, soil pathogens and cold soil temperatures in Michigan, and karst topographic features in Georgia).

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 NOMINATED FOR CRITICAL USE

REGION	Michigan	SOUTHEASTERN US **	Georgia	Maryland & Delaware
YEAR	2009			
QUANTITY OF METHYL BROMIDE NOMINATED	See Appendix A	See Appendix A	See Appendix A	See Appendix A
TOTAL CROP AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION (M^2 OR HA) (NOTE: IGNORE REDUCTIONS FOR STRIP TREATMENT)	See Appendix A	See Appendix A	See Appendix A	See Appendix A
METHYL BROMIDE USE: **BROADACRE OR STRIP/BED** TREATMENT?	Strip	Strip	Strip	Strip
PROPORTION OF BROADACRE AREA WHICH IS TREATED IN STRIPS; E.G. 0.54, 0.67	0.58	0.58	0.58	0.58
FORMULATION (RATIO OF METHYL BROMIDE/CHLOROPICRIN MIXTURE) TO BE USED FOR CALCULATION OF THE CUE E.G. 98:2, 50:50	67:33	67:33	67:33	67:33
APPLICATION RATE* (KG/HA) FOR THE FORMULATION	See Appendix A	See Appendix A	See Appendix A	See Appendix A
DOSAGE RATE* (G/M^2) (I.E. ACTUAL RATE OF FORMULATION APPLIED TO THE AREA TREATED WITH METHYL BROMIDE/CHLOROPICRIN ONLY)	See Appendix A	See Appendix A	See Appendix A	See Appendix A

*Give here actual rate per treated area (e.g. the area directly treated under film) not rate per total area of field.
**Includes: Alabama, Arkansas, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, and Virginia

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. For details on these changes in usage requirements, please see Appendix B.

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

QUANTITY (KG) REQUESTED FOR PREVIOUS NOMINATION YEAR:	411,765
QUANTITY (KG) APPROVED BY PARTIES FOR PREVIOUS NOMINATION YEAR:	407,091
QUANTITY (KG) REQUIRED FOR YEAR TO WHICH THIS REAPPLICATION REFERS:	340,405
TREATED AREA (HA) REQUIRED FOR YEAR TO WHICH THIS REAPPLICATION REFERS	2,058

<u>Part B:</u> CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

TABLE B 1. KEY DISEASES AND WEEDS

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY DISEASE(S) AND WEED(S) TO SPECIES AND, IF KNOWN, TO LEVEL OF RACE	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
Michigan	Soilborne fungal diseases: *Phytophthora capsici* and *Fusarium oxysporum*	No effective post-emergence control available; 1,3- D + chloropicrin is not feasible as a methyl bromide alternative due to regulatory and technical restrictions on use. Low soil temperatures and regulatory restriction also means that use of 1,3 D or metam sodium cannot be used with low soil temperatures. While a recent trial in Michigan indicated good yields when alternatives were used at higher soil temperatures, data were highly variable and the study needs to be repeated in larger plots before technical feasibility can be confirmed.
SOUTHEASTERN US (Alabama, Arkansas, Georgia, Kentucky, Louisiana, Michigan, North Carolina, South Carolina, Tennessee, and Virginia)	Nutsedges: yellow (*Cyperus esculentus*), and purple (*Cyperus rotundus*); to a lesser extent: fungal diseases (*Phytophthora*, *Fusarium* spp.) and root knot nematodes (*Meloidogyne incognita*)	With the possible exception of spring-time use of a combination of fumigant alternatives (described elsewhere), no effective alternatives exist for control of nutsedge, due to either lack of registration, planting delays (due to regulatory restriction or phytotoxicity) or low efficacy, or lack of registration of potentially effective herbicides, all of which result in significant economic loss. In part of this region, fungal diseases may also have no effective control in the absence of MB, due to regulatory restrictions and planting delays associated with 1,3 D + chloropicrin use.
Georgia	Nutsedges: yellow (*Cyperus esculentus*), and purple (*Cyperus rotundus*); fungal diseases (mainly *Pythium* spp.); to a lesser extent: root knot nematodes (*Meloidogyne incognita*)	With the exception of spring-time use of a combination of fumigant alternatives (described elsewhere), no effective alternatives exist for control of nutsedge, due to either lack of registration, planting delays (due to regulatory restriction or phytotoxicity) or low efficacy, both of result in significant economic loss, or lack of registration of potentially effective herbicides. In part of this region**,** fungal diseases may also have no effective control in the absence of MB, due to regulatory restrictions on the only effective alternative (1,3 D + chloropicrin). Georgia may have a higher level of nematode pressure than the other southeastern states
Maryland and Delaware	*Fusarium oxysporum niveum* (3 races), yellow nutsedge, to a lesser extent: root knot nematodes (*Meloidogyne incognita*)	No effective alternatives exist for control of the nutsedge, due to either lack of registration, planting delays (due to regulatory restriction or phytotoxicity) or low efficacy, both of result in significant economic loss, or lack of registration of potentially effective herbicides. Also, at least 3 races of *Fusarium* pathogen exist in this region and also have significantly less control in the absence of methyl bromide.

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:	Transplants grown for cucurbit fruit production.
ANNUAL OR PERENNIAL CROP:	Annual
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Corn, soybeans, tomatoes, strawberries, other cucurbit crops. methyl bromide is not used for the other crops if applied once already in a given year.
SOIL TYPES:	Light to medium loam
FREQUENCY OF METHYL BROMIDE FUMIGATION:	Once every year for a given field
OTHER RELEVANT FACTORS:	Soil temperatures are low relative to the rest of the US cucurbit growing regions (see below)

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

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	Temperate 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	X	X	X							
KEY MARKET WINDOW						X						

TABLE B 2 B SOUTHEASTERN U.S. (EXCEPT GEORGIA): CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	SOUTHEASTERN U.S. (EXCEPT GEORGIA)
CROP TYPE:	Transplants grown for cucurbit fruit production.
ANNUAL OR PERENNIAL CROP:	Annual
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Other cucurbits, tobacco, grains, cotton
SOIL TYPES:	Low organic content, light to medium loam
FREQUENCY OF METHYL BROMIDE FUMIGATION:	Once every year
OTHER RELEVANT FACTORS:	

TABLE B 3 B SOUTHEASTERN U.S. (EXCEPT GEORGIA) - CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	Temperate USDA Plant Hardiness Zones 6b – 8b											
SOIL TEMP. (℃)	Not available.											
RAINFALL (mm)	163	124	109	87	78	146	113	202	109	116	54	76
OUTSIDE TEMP. (℃)	9.4	14.5	17.7	23.4	26	25.9	22.6	14.9	7.7	3.4	2.9	4.2
FUMIGATION SCHEDULE	**X**	**X**										**X**
PLANTING SCHEDULE	X	X	X		X	X						
KEY MARKET WINDOW							X					

TABLE B 2 C GEORGIA : CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	GEORGIA
CROP TYPE:	Transplants grown for cucurbit fruit production.
ANNUAL OR PERENNIAL CROP:	Annual (one)
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Other cucurbits, bell pepper, squash, eggplant
SOIL TYPES:	Light to medium loam, low organic matter
FREQUENCY OF METHYL BROMIDE FUMIGATION:	Once every year
OTHER RELEVANT FACTORS:	Karst topographic features are widespread in Georgia.

TABLE B 3 C GEORGIA : CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	Temperate USDA Plant Hardiness Zones 7a – 8b											
SOIL TEMP. *(℃)*	Not available.											
RAINFALL *(mm)*	206	108	148	248	0	158	84	122	109	137	37	131
OUTSIDE TEMP. *(℃)*	15	17.7	22.9	25.6	27.2	27.5	25.1	20	11.4	7.5	6.2	9.7
FUMIGATION SCHEDULE					**X**							**X***
PLANTING SCHEDULE	X				X	X						
KEY MARKET WINDOW						X**				X**		

Notes:

(1) * = This fumigation period is for a cantaloupe typically double cropped with squash, which is typically a spring application cycle; the other fumigation period shown is for cucumber usually double cropped with bell peer and squash usually double cropped with cabbage, both typically a fall cycle.

(2) ** = US-EPA assumes these are the key market windows based on harvest schedule supplied by the applicant. According to the applicant, harvests for fall cycle crops occur in October & November, those for spring cycle crops occur in May through July.

(3) Planting schedule is July and August for crops with a fall application cycle; March for those with a spring cycle.

TABLE B 2 D MARYLAND AND DELAWARE: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	MARYLAND & DELAWARE
CROP TYPE:	Transplants grown for cucurbit fruit production.
ANNUAL OR PERENNIAL CROP:	Annual (one)
TYPICAL CROP ROTATION AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:	Other cucurbits, bell pepper, squash, eggplant
SOIL TYPES:	Light to medium loam, low organic matter
FREQUENCY OF METHYL BROMIDE FUMIGATION:	Once every year
OTHER RELEVANT FACTORS:	Proximity of surface water (lagoons, streams, etc.) prevents 1, 3 D application on all acreage.

TABLE B 3 D MARYLAND & DELAWARE: CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	Temperate USDA Plant Hardiness Zones 7a											
SOIL TEMP. (℃)	10-21 during fumigation											
RAINFALL, TOTAL (mm)*	102.9	64	148.3	166.9	179.6	44.7	9.1	215.4	91.4	90.4	102.6	77.2
OUTSIDE TEMP., MEANS (℃)*	4.1	11.4	13.6	21.6	24.9	24.4	20.7	14.4	9.3	1.7	1.7	2.6
FUMIGATION SCHEDULE		X										
PLANTING SCHEDULE		X	X	X								
KEY MARKET WINDOW					X							

* Data shown are for 2005 and from a single station in the growing region (Wicomico Regional Airport)

(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-dichloropropene + 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 cucurbit 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 in this sector in certain areas of the southeastern U.S. In Georgia, karst topographic features prevent 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 Maryland and Delaware, the situation is similar to Michigan, in that 1,3 D + chloropicrin and metam-sodium/potassium use is hindered by environmental conditions. Since the crop acreage involved is in low-lying coastal plain, water-logged soils frequently occur in rain events near the fumigation period; in addition water tables may be too close to the surface to allow timely fumigation with these materials. This could delay fumigation with these alternatives and cause additional losses by forcing growers to miss key mid-July market windows.

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

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

TABLE B 4 A MICHIGAN . HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2001	2002	2003	2004	2005	2006
AREA TREATED *(hectares)*	567	589	224	239	275	237
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	100% strip	100% strip	100% strip	100% strip	100% strip	100% strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	27,331	28,403	26,934	28,719	32,985	28,442
FORMULATIONS OF METHYL BROMIDE	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	15.0	15.0	15.0	15.0	15.0	15.0

* *Applications are made as strip treatments.*

TABLE B 4 B SOUTHEASTERN U.S. (EXCEPT GEORGIA) . HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2001	2002	2003	2004	2005	2006
AREA TREATED *(hectares)*	5,034	5,253	5,658	5,941	6,022	6,385
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	100% strip	100% strip	100% strip	100% strip	100% strip	100% strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	756,120	788,942	849,723	892,270	904,426	959,129
FORMULATIONS OF METHYL BROMIDE	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	16.7	16.7	16.7	16.7	16.7	16.7

* *Applications are made as strip treatments.*

TABLE B 4 C GEORGIA – CUCUMBER. HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2001	2002	2003	2004	2005	2006
AREA TREATED *(hectares)*	618	608	584	590	579	614
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	92,874	91,284	87,642	88,558	86,917	92,266
FORMULATIONS OF METHYL BROMIDE	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	16.5	16.5	16.5	16.5	16.5	16.5

* *Applications are made as strip treatments.*

TABLE B 4 D GEORGIA – SQUASH. HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2001	2002	2003	2004	2005	2006
AREA TREATED *(hectares)*	618	578	572	550	519	643
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	92,874	86,857	85,945	82,602	77,982	96,582
FORMULATIONS OF METHYL BROMIDE	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	16.7	16.7	16.7	16.7	16.7	16.7

* *Applications are made as strip treatments.*

TABLE B 4 E GEORGIA – MELON. HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2001	2002	2003	2004	2005	2006
AREA TREATED *(hectares)*	1,636	1,581	1,776	1,591	1,289	1,778
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	245,739	237,473	266,769	238,992	193,649	267,073
FORMULATIONS OF METHYL BROMIDE	67:33	67:33	67:33	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	16.8	16.8	16.8	16.8	16.8	16.8

* *Applications are made as strip treatments.*

TABLE B 4 F MARYLAND –MELONS - HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	2001	2002	2003	2004	2005	2006
AREA TREATED *(hectares)*	544	544	544	544	544	544
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip	100% Strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	17,923	17,923	17,923	9,190	9,190	9,190
FORMULATIONS OF METHYL BROMIDE	98:2	98:2	98:2	67:33	67:33	67:33
METHOD BY WHICH METHYL BROMIDE APPLIED	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected	Shank injected
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	15.0	15.0	15.0	15.0	15.0	15.0

* *Applications are made as strip treatments.*

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
CHEMICAL ALTERNATIVES	
1,3 D + chloropicrin	In small plot trials conducted in Michigan, this formulation showed some efficacy against the key pests (Hausbeck and Cortright, 2004). Plant loss was about 6 % as compared to 0 % with MB. Perhaps more significantly, the average yield loss for the four cucurbit crops evaluated (zucchini, acorn squash, melons, and watermelons) was 44%, as compared to the methyl bromide standard. Furthermore, regulatory restrictions and Michigan's cool and wet soils result in a delay of up to 30 days in planting after treatment with this formulation. This results in growers missing key harvest windows, with consequent negative economic impacts In the southeastern US this material has been effective (in small plot studies) in controlling disease and nematode pests, but not nutsedges (Locascio et al., 1997; Csinos et al., 1999; Noling et al., 2000). Subject to regulatory restrictions in some areas (where Karst topographic features exist). See additional discussion in narrative statements below.
Metam-sodium	Provides control of nutsedges only close to application site (Dowler, 1999; Locascio and Dickson, 1998). Surviving nutsedge tubers can potentially recolonize the crop field (Webster, 2002). Not effective against the disease or nematode pests in this region. Approximate yield losses due to nutsedge are 3 – 25 %; losses would be higher in areas facing the other key pests along with nutsedges. Technically and economically infeasible due to these yield losses (see economic analyses in Part E). In the cool conditions of Michigan, metam-sodium is likely to be slow to transform into the active ingredient (methyl isothiocyanate), which suggests that pest control will not be as effective as in the more favorable Florida conditions. However, given the high variability of data in those trials, and the inconsistent results cited for tomato, it is not clear that this combination of alternatives will provide reliable pest management in the absence of MB. See additional discussion in narrative statements below.
NON CHEMICAL ALTERNATIVES	
Soil solarization	Michigan's climate is typically cool (less than 11^{o} C frequently through May) and cloudy, particularly early in the growing season when control of the key pests is particularly important. In Michigan, the growing season is particularly short (May to September), so 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.
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 the open cucurbit 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 cucurbits in Michigan. The bacterium *Burkholderia 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 (included in the 2002 application from this region), *P. capsici* was not controlled adequately in summer squash, a cucurbit crop, by either of these beneficial microorganisms.
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 cucurbit 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 render cover crops ineffective as a stand-alone management alternative to methyl bromide.
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 cucurbits 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) apparently suppress some plant pathogens in cucumber (MBTOC, 1994), there is no such information for the other cucurbit crops grown in Michigan. Furthermore, the target pathogens of the study did not include *P. capsici*, probably the greatest threat to Michigan cucurbits.
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 cucurbit growers. It is unclear whether irrigation methods in this region could be adapted to incorporate flooding or alter water management for cucurbit 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.	Grafting of *Fusarium* resistant rootstock has been studied in watermelon in the southern US. While results have been promising, the approach is not yet technically and economically feasible as a methyl bromide alternative for commercial US watermelon production. Costs to use resistant stock remains too high for the typical grower, and negative interactions between the rootstock and scion remain to be resolved to ensure reliable crop production (Roberts et al. 2007, Taylor et al. 2007, Bruton personal communication). The use of grafting for other US cucurbits for any of the key pests is not undergoing commercial development, as far as the USG can ascertain. Soilless culture, organic production, and substrates/plug plants are also not technically viable alternatives to methyl bromide for fungi in open field cucurbit production. 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.
COMBINATION OF ALTERNATIVES	

Metam sodium + Chloropicrin	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). Low efficacy in even small-plot trials indicates that this is not a technically feasible alternative for commercially produced cucurbits at this time. These studies apparently did not measure yield impacts, and did not involve cucurbits. Trials with metam-potassium + chloropicrin on small plots in Michigan showed yields of 4 cucurbit crops to be statistically similar to those obtained with methyl bromide (Hausbeck and Cortright, 2003). However, given the high variability of data in those trials, and the inconsistent results cited for tomato, it is not clear that this combination of alternatives will provide reliable pest management in the absence of MB. Gilreath et al (2005) also reported control of nutsedge with metam + pic, but it was not as consistent as control with methyl bromide. See additional discussion in narrative statements below.
1,3 D + Metam-sodium	Trials in tomato have shown inconsistent efficacy of this formulation 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 cucurbits in Michigan at this time. These studies apparently did not measure yield impacts, and did not involve cucurbits. The study in Michigan mentioned for other alternatives (Hausbeck and Cortright, 2003) did not address this combination. See additional discussion in narrative statements below.

* Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.
** Citations should be recorded by a number only, to indicate citations listed in Question 22.

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

TABLE C 2. ALTERNATIVES DISCUSSION

Halosulfuron-methyl	Herbicide: causes potential crop injury; has plant back restrictions. Efficacy is lowered in rainy conditions (common during the period of initial planting of these crops). Also, a 24-month plant back restriction may cause significant economic disruption if growers must rely on this control option. Halosulfuron is only allowed for the row middles for cucurbits, due to its phytotoxicity. This would result in nutsedges surviving close to crop plants. Thus this herbicide is not technically feasible as a stand-alone replacement for methyl bromide, and its use in conjunction with other pest management methods has not yet been investigated.
Glyphosate	Herbicide: Is non-selective; like halosulfuron, it will not control nutsedge within the plant rows; does not provide residual control. Thus this herbicide is not technically feasible as a stand-alone replacement for MB, and its use in conjunction with other pest management methods has not yet been investigated.
Paraquat	Herbicide: Is non-selective; will not control nutsedge in the plant rows; does not provide residual control. Thus this herbicide is not technically feasible as a stand-alone replacement for MB, and its use in conjunction with other pest management methods has not yet been investigated.
Trifloxysulfuron	Not registered on cucurbits
S-metolachlor	Not registered on cucurbits

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

Narrative description of studies relevant to key pathogens

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). Iodomethane (currently unregistered for cucurbits) 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 in the warmer regions of the southeastern US, 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. Iodomethane 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 iodomethane plots. The proportion of unmarketable squash fruit (defined only as those fruit so bad as to have to be discarded) in the 1,3 D plots was 30 % worse than that in the methyl bromide plots, though in the iodomethane plots it was equivalent to methyl bromide .

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 cucurbit growing regions of Michigan. Given the highly variable results with this methyl bromide alternative, USG has decided that the best case yield loss scenario for Michigan and the mid-Atlantic (Maryland and Delaware) – where *Fusarium* and/or *Phythophthora* are the main pests - would be a level similar to what was assessed in the 2006 CUN.

In a recent study by Hausbeck and Cortright (2007a, b) cucurbit plant vigor was measured to determine fumigant/mulch performance under either LPDE or VIF plastic mulch for the control of *Fusarium oxypsorum*. Of the fumigants used in the study, the methyl bromide and iodomethane treatments resulted in cantaloupe plants with the highest vigor. In general, treatments under LPDE had the higher plant vigor when compared with plants grown under VIF. Another conclusion of this work is that in cooler climates, spring planting of cucurbit crops into VIF mulch requires longer periods of off-gassing for crop safety (Table C 3). This is believed to be due to the increased soil persistence during low temperatures. Longer plantback times would mean premium market windows are more likely to be missed. Furthermore, VIF tarps were prone to wind removal, which reduces their reliability under local growing conditions.

TABLE C 3 MICHIGAN REGION: Evaluation of Fumigants and Plastic Mulches for Managing *Fusarium* in Cucurbit Crops 2007

Treatment (time after treatment to planting)	Rate of formulated product	Vigor*	
Untreated control under LDPE (5 days)		1.0-1.3	a**
Iodomethane+chloropicrin 50:50 under LDPE (10 days)...............	196 kg/ha	1.0	a
Iodomethane+chloropicrin 50:50 under VIF (10 days)	196 kg/ha	3.0	c
Methyl bromide+chloropicrin 67:33 under LDPE (10 days)..........	280 kg/ha	1.0	a
Methyl bromide+chloropicrin 67:33 under VIF (10 days)	280 kg/ha	2.7	bc
1,3 D + chloropicrin 65:35 under LDPE (21 days).........................	187 liters/ha	2.3	bc
1,3 D + chloropicrin 65:35 under VIF (21 days)	187 liters/ha	4.7	d
Chloropicrin under LDPE (14 days)	187 liters/ha	2.7	c
Chloropicrin under VIF (14 days)	187 liters/ha	3.3	cd

*Vigor rating of plant health; 1=healthy plants with no stunting, 5= moderated plant stunting with variable stand, 10=complete plant death.
**Column means with a letter in common are not significantly different (Fisher LSD Method; *P*=0.05).
From Hausbeck and Cortright 2007a.

While this research was conducted with *F. oxysporum* as the key pest, the results and the practical limitations of VIF that were seen are likely to be similar for *P. capsici*, the other key pest in the Michigan region (Cortright, personal communication). The reader is reminded here that while iodomethane was included in this study, the material remains unregistered for cucurbits in the U.S.

In addition to the limitations of VIF discussed above, the USG notes that the plant vigor in 1,3 D treatments in these new trials is lower than that seen in methyl bromide treatments. This is similar to what was seen in previous year's tests (Hausbeck and Cortright 2004; see earlier discussion). Therefore, the USG continues to use the best case yield loss estimates from the previous year's nominations for the Michigan and Maryland/Delaware regions, since these need methyl bromide mainly for *F. oxysporum* and/or *P. capsici* control.

B: KEY WEEDS

Narrative description of studies relevant to key weeds

For nutsedge pests, which are widespread in all requesting regions except Michigan, cucurbit 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 isothiocyanate 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 cucurbits, 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 iodomethane. 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).

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, iodomethane 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 nutsedge 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., Delaware, Maryland, and Virginia).

TABLE C 4. DATA ON WEED CONTROL

Chemicals	Rate (kg/ha)	Average Nutsedge Density (#/m^2)	Average Marketable Yield (ton/ha)	% Yield Loss (compared to MB)
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

Locascio et al. 1997.

In addition to the studies described above, several other recent studies conducted in the production circumstances of the southeastern US have examined several fumigant alternatives to methyl bromide, most done in crops other than cucurbits/peppers (e.g., Santos et al. 2006, Candole et al. 2007, Santos and Gilreath 2007, Gilreath and Santos 2005, 2007). These studies either focused solely on nutsedge weeds or a combination of nutsedges, diseases, and nematodes. However, USG has examined these papers and concludes that for cucurbits, these studies do not meet all the criteria that allowed the use of earlier studies in estimating yield and quality losses that may occur if such methyl bromide alternatives are used as direct replacements for methyl bromide.

These criteria are: the use of fumigant alternatives registered for the crop nominated, the presence of both a methyl bromide standard and an untreated control as treatments as well as the monitoring of yields under each treatment. Several such studies included a methyl bromide treatment or an untreated control but not both (Santos and Gilreath 2007, Johnson and Mullinix 2007), or included both but did not monitor yield (Candole et al. 2007), or included unregistered alternatives (e.g., Gilreath and Santos 2005, 2007, Santos et al. 2006). While these studies (the majority of which were small-plot trials) indicate continued promise of methyl bromide alternatives such as 1,3-D, metam-sodium, chloropicrin, herbicides, or combinations thereof, they cannot yet be used to alter yield estimates**.** Finally, these studies were all conducted in the southeastern US, and therefore also cannot be applied to the production circumstances of Michigan, which is much further north and may have different soil characteristics as well.

More useful (within the context of this nomination) is the series of studies being conducted by Culpepper et al. at the University of Georgia (e.g., Culpepper 2006, Culpepper et al. 2007a,b, Culpepper 2006). These studies indicate that a 3-way, sequential combination of several fumigant alternatives is technically feasible for spring-time fumigation of most vegetable crops. The 3-way combination consists of 1,3 D + chloropicrin ("Telone C35" brand), followed by chloropicrin at about 168 kg/ha, followed by metam-sodium, all under VIF or metallized (high barrier) tarps, and will henceforth be referred to as the 'UGA 3 way', as Culpepper et al. have. An example of the results obtained in spring fumigation with this combination in peppers is presented in the table below. Results have been similar for cucurbit crops (Culpepper, personal communication; also see several research reports available from the University of Georgia at www.gaweed.com).

TABLE C 5. NUMBER OF PEPPER FRUIT - METHYL BROMIDE: CHLOROPICRIN VERSUS THREE WAY COMBINATION. SPRING 2006

Fruit Size	Methyl Bromide : Chloropicrin (# of Fruit)	UGA 3 way 1,3-D fb chloropicrin 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 were 3 rows by 100 feet long.

Since Georgia is similar to other areas of the southeastern US, except Maryland/Delaware cucurbits which face a different key pest, these results should be applicable to spring usage of methyl bromide in these regions. However, other results thus far indicate that fall fumigation is not effective with this combination of alternatives (Culpepper, personal communication, Culpepper 2006). For these fumigations, and for fumigations in Maryland and Delaware (where the key pests are different), USG has used the technical assessment of methyl bromide alternatives described at the beginning of this section.

It is important to note that caveats accompany even the technical feasibility of the 'UGA 3 way'. Growers must make several application modifications to properly use the approach, and this may incur significant capital expenditure. Culpepper et al. estimate their costs to do this for their research trials at about $ 15,000 (Culpepper et al. 2007b). Application costs will also increase as more chemicals and runs of tractor equipment are required to conduct the 'UGA 3 way', and the cost of VIF or metallized film is between 1.75 and two times greater than standard LBPF (Culpepper personal communication). The economic implications of these aspects are discussed further in section E, below.

In addition, the durability of high barrier films (VIF and metallized film) under the multiple crop cycle typically used in Georgia is unknown. Reports in 2007 from growers suggest that these films wear out after two cropping cycles, as opposed to up to four for standard LPBF (Culpepper, personal communication). Further, the promising results seen for spring fumigation were obtained from small plots and have only recently been conducted in commercially sized fields (Culpepper, personal communication). Results are still under analysis and at least one more repetition is probably necessary for growers to confidently rely on the approach as a methyl bromide replacement. Therefore, time will be necessary for growers to transition to this pest management strategy.

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

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

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.

Iodomethane: Received a one-year registration in October 2007 but not for cucurbit crops. Registration will be reviewed at the end of the one year period.

Propargyl bromide: Under proprietary development for future registration submission.

Sodium azide: Under proprietary development for future registration submission.

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

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

Muscador albus Strain QST 20779. Registered but no commercially available formulation.

In Michigan the critical use exemption application states that 1,3-D + chloropicrin, metam-sodium, iodomethane, sodium azide, and furfural will continue to be under investigation as methyl bromide alternatives. Some of these alternatives are currently unregistered for use on pepper, with the exception of iodomethane, there are presently no commercial entities pursuing registration in the United States. The timeline for developing the above-mentioned methyl bromide alternatives in Michigan is as follows:
2003 – 2005: Test for efficacy (particularly against the more prevalent *Phytophthora*)
2005 – 2007: Establish on-farm demonstration plots for effective methyl bromide alternatives

2008 – 2010: Work with growers to implement commercial use of effective alternatives.

Research is also under way to optimize the use of a 50 % methyl bromide: 50 % chloropicrin formulation to replace the currently used 67:33 formulation. In addition, field research is being conducted to optimize a combination of crop rotation, raised crop beds, plastic mulches and foliar fungicides. Use of virtually impermeable film (VIF) is ongoing and they are expected to be a replacement for the currently used low density polyethylene (LDPE), however, the lack of infrastructure to recycle VIF could remain an obstacle. In addition, concerns over requirements for longer off-gassing time in cold regions of the country, such as Michigan, (Hausbeck and Cortright, 2007) for cucurbit crops planted into impermeable mulches where chloropicrin mixtures have been applied will need to be addressed in future research for other crops. Impacts of impermeable mulches would need to be tested with methyl bromide + chloropicrin or any other fumigant combination under local conditions with the testing conducted over multiple seasons to provide information on year to year variability. Due to the short production season in Michigan, any fumigation system that would delay planting may result in producers missing key market timings.

Research continues to also be conducted to identify *Fusarium* resistant watermelon stock that can be grafted on a commercially feasible basis. While rootstocks protective under conditions of low to moderate pathogen infestation have been identified and tested, this work will require several more years before it produces methyl bromide alternatives that are both technically and economically feasible, and that functions under severe infestations. Such work is being planned in the southeastern US (Roberts et al. 2007, Taylor et al. 2007, Bruton, personal communication).

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

No. Areas where methyl bromide is not used in this region do not face moderate to severe populations of the key pests. Areas that do not have moderate to severe pest pressure and do not face regulatory constraints can use other fumigants (e.g. 1,3-dichloropropene, chloropicrin, metam sodium or combinations of the three).

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

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

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

No studies have been done to demonstrate technical and economic feasibility of such systems in open field cucurbit crops in the US. None appear to be planned by US researchers for the near future.

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. For example, changes in buffer zones, new township caps, new safety requirements (affecting costs and feasibility), and new environmental restrictions such as to protect ground water or other natural resources. Where a potential alternative identified in the original nomination's transition plan has subsequently been deregistered, the nominating Party would report the deregistration, including reasons for it. The nominating Party would also report on the deregistration's impact (if any) on the exemption holder's transition plan and on the proposed new or alternative efforts that will be undertaken by the exemption holder to maintain the momentum of transition efforts.

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

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

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

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

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

TABLE D 1. TECHNIQUES TO MINIMIZE USE AND EMISSIONS.

TECHNIQUE OR STEP TAKEN	LOW PERMEABILITY BARRIER FILMS	METHYL BROMIDE DOSAGE REDUCTION	INCREASED % CHLOROPICRIN IN METHYL BROMIDE FORMULATION	DEEP INJECTION	LESS FREQUENT APPLICATION
WHAT USE/EMISSION REDUCTION METHODS ARE PRESENTLY ADOPTED?	Currently some growers use HDPE tarps.	Growers have switched from a 98% methyl bromide 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.	See above.	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. Measures adopted in Michigan will likely be used in the other regions when fungi are the only key pests involved				

Some studies in Florida have indicated that lower rates of methyl bromide + chloropicrin can be used under VIF or metallized films to effectively control key pests there (Gilreath et al. 2005, Culpepper's studies available at www.gaweed.com). Extension publications in Florida suggest that rates as low as 60 % of the standard 392 kg/ha of the 67:33 formulation of methyl bromide +

chloropicrin is usable for the suite of key pests there (Noling and Botts 2007, Gilreath 2006, Noling 2006), and this rate is likely to be feasible for the rest of the southeast as well (Culpepper, personal communication). Due to reduced availability of methyl bromide growers have been trying rates at such levels and even lower, but these are not controlled experiments.

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.
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. **Therefore, these methods have been deemed currently infeasible for use in the acreage requesting methyl bromide in this nomination.**

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

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

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

(Renomination Form 14.) USE/EMISSION MINIMISATION MEASURES

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

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

As methyl bromide has become more scarce, users in the United States have, where possible, experimented with different mixes of methyl bromide and chloropicrin. Specifically, in the early 1990s, methyl bromide was typically sold and used in methyl bromide mixtures made up of 98% methyl bromide and 2% chloropicrin, with the chloropicrin being included solely to give the chemical a smell enabling those in the area to be alerted if there was a risk. However, with the outset of very significant controls on methyl bromide, users have been experimenting with significant increases in the level of chloropicrin and reductions in the level of methyl bromide. While these new mixtures have generally been effective at controlling target pests, at low to moderate levels of infestation, it must be stressed that the long term efficacy of these mixtures is unknown.

Tarpaulin (high density polyethylene) is also used to minimize use and emissions of methyl bromide. In addition, cultural practices are utilized by cucurbit 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 above in Item 18.

<u>Part E:</u> ECONOMIC ASSESSMENT
<u>Renomination Form Part F:</u> 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 2010 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 in the 2010 application. 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 E16 by geographic location.

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

TABLE E 1. MICHIGAN CUCUMBER: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

MICHIGAN CUCUMBER	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	1,960	1,842
* PRICE PER UNIT (US$)	$12	$11
= GROSS REVENUE PER HECTARE (US$)	$23,358	$20,858
- OPERATING COSTS PER HECTARE (US$)	$20,171	$19,505
= NET REVENUE PER HECTARE (US$)	$3,187	$1,354
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,833
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$15
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	8%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	58%
5. OPERATING PROFIT MARGIN (%)	14%	6%

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

MICHIGAN MELON	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	1,236	1,161
* PRICE PER UNIT (US$)	$12	$11
= GROSS REVENUE PER HECTARE (US$)	$14,209	$12,688
- OPERATING COSTS PER HECTARE (US$)	$11,797	$11,885
= NET REVENUE PER HECTARE (US$)	$2,412	$803
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,609
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$13
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	11%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	67%
5. OPERATING PROFIT MARGIN (%)	17%	6%

TABLE E 3. MICHIGAN HARD SQUASH-: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

MICHIGAN HARD SQUASH	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	1,174	1,103
* PRICE PER UNIT (US$)	$12	$11
= GROSS REVENUE PER HECTARE (US$)	$13,909	$12,421
- OPERATING COSTS PER HECTARE (US$)	$14,697	$14,478
= NET REVENUE PER HECTARE (US$)	$(788)	$(2,057)
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,270
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$11
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	9%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	-161%
5. OPERATING PROFIT MARGIN (%)	-6%	-17%

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

MICHIGAN ZUCCHINI	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	2,718	2,555
* PRICE PER UNIT (US$)	$6	$5
= GROSS REVENUE PER HECTARE (US$)	$14,950	$13,350
- OPERATING COSTS PER HECTARE (US$)	$22,146	$21,352
= NET REVENUE PER HECTARE (US$)	$(7,196)	$(8,002)
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$806
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$7
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	5%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	-11%
5. OPERATING PROFIT MARGIN (%)	-48%	-60%

TABLE E 5. ALL MICHIGAN CUCURBITS -: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

ALL MICHIGAN CUCURBITS	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	1,772	1,665
* PRICE PER UNIT (US$)	$10	$10
= GROSS REVENUE PER HECTARE (US$)	$18,059	$16,126
- OPERATING COSTS PER HECTARE (US$)	$17,205	$16,654
= NET REVENUE PER HECTARE (US$)	$854	$(528)
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,382
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$12
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	8%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	162%
5. OPERATING PROFIT MARGIN (%)	5%	-3%

TABLE E 6. SOUTHEASTERN USA (EXCEPT GEORGIA) CUCUMBER -: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEAST USA (EXCEPT GEORGIA) CUCUMBER	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	828	588	464
* PRICE PER UNIT (US$)	$15	$15	$15
= GROSS REVENUE PER HECTARE (US$)	$12,417	$8,816	$6,954
- OPERATING COSTS PER HECTARE (US$)	$10,193	$9,876	$9,404
= NET REVENUE PER HECTARE (US$)	$2,224	$(1,060)	$(2,451)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$3,284	$4,675
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$22	$31
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	26%	38%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	148%	210%
5. OPERATING PROFIT MARGIN (%)	18%	-12%	-35%

TABLE E 7. SOUTHEASTERN USA (EXCEPT GEORGIA) MELONS - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEAST USA (EXCEPT GEORGIA) MELON	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	815	579	457
* PRICE PER UNIT (US$)	$14	$14	$14
= GROSS REVENUE PER HECTARE (US$)	$11,416	$8,106	$6,393
- OPERATING COSTS PER HECTARE (US$)	$9,316	$9,199	$8,918
= NET REVENUE PER HECTARE (US$)	$2,100	$(1,094)	$(2,525)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$3,194	$4,625
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$21	$31
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	28%	41%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	152%	220%
5. OPERATING PROFIT MARGIN (%)	18%	-13%	-39%

TABLE E 8. SOUTHEASTERN USA (EXCEPT GEORGIA) SQUASH -: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEAST USA (EXCEPT GEORGIA) SQUASH	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	311	221	174
* PRICE PER UNIT (US$)	$26	$26	$26
= GROSS REVENUE PER HECTARE (US$)	$8,095	$5,748	$4,533
- OPERATING COSTS PER HECTARE (US$)	$5,923	$6,240	$6,094
= NET REVENUE PER HECTARE (US$)	$2,173	$(492)	$(1,561)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$2,665	$3,734
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$18	$25
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	33%	46%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	123%	172%
5. OPERATING PROFIT MARGIN (%)	27%	-9%	-34%

TABLE E 9. ALL SOUTHEASTERN US (EXCEPT GEORGIA) CUCURBITS - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

ALL SOUTHEAST US (EXCEPT GEORGIA) CUCURBITS	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	749	532	420
* PRICE PER UNIT (US$)	$15	$15	$15
= GROSS REVENUE PER HECTARE (US$)	$11,229	$7,972	$6,288
- OPERATING COSTS PER HECTARE (US$)	$9,085	$8,052	$7,313
= NET REVENUE PER HECTARE (US$)	$2,144	$(79)	$(1,025)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$2,223	$3,168
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$15	$21
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	20%	28%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	104%	148%
5. OPERATING PROFIT MARGIN (%)	19%	-1%	-16%

TABLE E 10. GEORGIA CUCUMBER - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

GEORGIA CUCUMBER	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	5,889	4,181	3,298
* PRICE PER UNIT (US$)	$9	$9	$9
= GROSS REVENUE PER HECTARE (US$)	$52,084	$36,980	$29,167
- OPERATING COSTS PER HECTARE (US$)	$46,200	$38,463	$34,403
= NET REVENUE PER HECTARE (US$)	$5,884	$(1,483)	$(5,236)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$7,367	$11,120
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$49	$74
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	14%	21%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	125%	189%
5. OPERATING PROFIT MARGIN (%)	11%	-4%	-18%

TABLE E 11. GEORGIA MELON ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

GEORGIA MELON	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	3,576	2,539	2,002
* PRICE PER UNIT (US$)	$11	$11	$11
= GROSS REVENUE PER HECTARE (US$)	$38,386	$27,254	$21,496
- OPERATING COSTS PER HECTARE (US$)	$34,256	$29,788	$27,163
= NET REVENUE PER HECTARE (US$)	$4,130	$(2,534)	$(5,667)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$6,664	$9,797
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$44	$65
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	17%	26%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	161%	237%
5. OPERATING PROFIT MARGIN (%)	11%	-9%	-26%

TABLE E 12. GEORGIA SQUASH - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

GEORGIA SQUASH	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	5,189	3,684	2,906
* PRICE PER UNIT (US$)	$7	$7	$7
= GROSS REVENUE PER HECTARE (US$)	$36,695	$26,054	$20,549
- OPERATING COSTS PER HECTARE (US$)	$32,167	$27,688	$25,262
= NET REVENUE PER HECTARE (US$)	$4,528	$(1,634)	$(4,713)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$6,162	$9,241
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$41	$62
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	17%	25%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	136%	204%
5. OPERATING PROFIT MARGIN (%)	12%	-6%	-23%

TABLE E 13. ALL GEORGIA CUCURBITS - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

ALL GEORGIA CUCURBITS	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	4,328	3,073	2,424
* PRICE PER UNIT (US$)	$9	$9	$9
= GROSS REVENUE PER HECTARE (US$)	$40,268	$28,590	$22,550
- OPERATING COSTS PER HECTARE (US$)	$35,756	$30,744	$27,927
= NET REVENUE PER HECTARE (US$)	$4,511	$(2,154)	$(5,377)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$6,666	$9,889
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$44	$66
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	17%	25%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	148%	219%
5. OPERATING PROFIT MARGIN (%)	11%	-8%	-24%

TABLE E 14. MARYLAND AND DELAWARE MELON - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

MARYLAND AND DELAWARE MELON	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	6%	6%
YIELD PER HECTARE	865	813
* PRICE PER UNIT (US$)	$9	$8
= GROSS REVENUE PER HECTARE (US$)	$7,351	$6,565
- OPERATING COSTS PER HECTARE (US$)	$6,981	$6,981
= NET REVENUE PER HECTARE (US$)	$371	$(416)
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$787
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$10
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	11%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	212%
5. OPERATING PROFIT MARGIN (%)	5%	-6%

SUMMARY OF ECONOMIC FEASIBILITY

There are currently few alternatives to methyl bromide for use in cucurbits. Furthermore, there are several factors that limit possible alternatives' usability and efficacy. These include pest complex, climate, and regulatory restrictions. The two most promising alternatives to methyl bromide in Georgia and the Southeastern USA for control of nut-sedge in cucurbits (1,3-D + chloropicrin and metam-sodium) are considered not technically feasible. This derives from regulatory restrictions and the magnitude of resulting expected yield losses. Economic data representing Georgia and Southeastern USA cucurbit growing conditions are thus included in the economic assessment 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. In Michigan, Maryland, and Delaware 1,3-D + chloropicrin is considered feasible from a technical perspective. Data describing economic growing conditions is presented below and describes the economic feasibility of using1,3-D + chloropicrin in the place of methyl bromide.

Michigan

The US concludes that, at present, no economically feasible alternatives to methyl bromide exist for use in Michigan cucurbit production. The US has arrived at this conclusion by examining the individual crops within the Michigan cucurbit sector and then examining the sector as a whole. Yield loss and missed market windows, which are discussed individually below, have proven most important in reaching this conclusion.

<u>1. Yield Loss</u>

Expected yield losses of 6% are anticipated throughout Michigan cucurbit production.

<u>2. Missed Market Windows</u>

USG 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 cucurbits 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 cucurbits are harvested, the supply is at its lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, cucurbit growers manage their production systems with the goal of harvesting the largest possible quantity of cucurbits when the prices are at their highs. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of cucurbit operations.

To describe economic conditions in Michigan, EPA used weekly and monthly cucurbit sales and production data from the U.S. Department of Agriculture for the previous three years to gauge the impact of early season price fluctuations on gross revenues. Though data availability was limiting, analysts assumed that if cucurbit growers adjust the timing of their production system, as required when using 1,3-D + Chloropicrin, gross revenues will decline by approximately 5%

over the course of the growing season, due solely to price effects. The season average price was reduced by 5% in the analysis of the alternatives to reflect this effect. Based on currently available information, the US believes this reduction in price serves as a reasonable indicator of the typical effect of planting delays resulting when methyl bromide alternatives are used in Michigan.

Maryland and Delaware

The US concludes that, at present, no economically feasible alternatives to methyl bromide exist for use in Maryland and Delaware melon production. As with Michigan, yield loss and missed market windows, which are discussed individually below, have proven most important in reaching this conclusion.

1. Yield Loss

Expected yield losses of 6% are anticipated throughout Maryland and Delaware melon production.

2. Missed Market Windows

USG agrees with Maryland and Delaware'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 cucurbits 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 cucurbits are harvested, the supply is at its lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, cucurbit growers manage their production systems with the goal of harvesting the largest possible quantity of cucurbits when the prices are at their highs. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of cucurbit operations.

To describe economic conditions in Maryland and Delaware melon production, EPA used weekly and monthly cucurbit sales and production data from the U.S. Department of Agriculture for the previous three years to gauge the impact of early season price fluctuations on gross revenues. Though data availability was limiting, analysts assumed that if cucurbit growers adjust the timing of their production system, as required when using 1,3-D + Chloropicrin, gross revenues will decline by approximately 5% over the course of the growing season, due solely to price effects. The season average price was reduced by 5% in the analysis of the alternatives to reflect this effect. Based on currently available information, the US believes this reduction in price serves as a reasonable indicator of the typical effect of planting delays resulting when methyl bromide alternatives are used in Maryland and Delaware melon production.

Southeastern USA Except Georgia

No technically (and thus economically) feasible alternatives to methyl bromide are presently available to the cucurbit growers who produce in karst soils. As such, the US concludes that use of methyl bromide is critical in Southeastern USA cucurbit production in these soils. For production in non-karst areas the application of 1,3-D, pic, and metam in sequence, for spring fumigations, to produce results that are comparable to those obtained with methyl bromide. The USG factored this development into its request by adding a second transition of :remaining spring fumigation in non-karst areas divided by four (to allow a four year transition). This amount was subtracted from the total after other adjustments had been made.

Analytical Notes

The applicant provided no data on the operating costs of alternatives. Analysts assumed, however, that these costs were similar to those of methyl bromide with slight upward adjustments for the costs of applying the alternatives and a slight downward adjustment for the cost of the alternative product. In addition, the applicant did not provide data for second crops (including revenues and operating costs). Analysts assumed that Southeastern cucurbits are grown in a single crop production system. However, if double cropping is practiced in the actual production system, this assumption could make the critical need for methyl bromide appear smaller than it actually is, because the value the second crop derives from methyl bromide is not included in the analysis

Other potentially significant economic factors, such as price reductions due to missed market windows, were not analyzed for this region, as the case for critical use of methyl bromide is sufficiently strong based solely on yield loss.

Georgia

No technically (and thus economically) feasible alternatives to methyl bromide are presently available to the effected cucurbit growers producing in areas of karst topography. As such, the US concludes that use of methyl bromide is critical in Georgia cucurbit production in these soils. For production in non-karst areas the application of 1,3-D, pic, and metam in sequence, for spring fumigations, to produce results that are comparable to those obtained with methyl bromide. The USG factored this development into its request by adding a second transition of :remaining spring fumigation in non-karst areas divided by four (to allow a four year transition). This amount was subtracted from the total after other adjustments had been made. Note that data describing Georgia cucurbit production is based on double cropping production practices.

Analytical Notes

Other potentially significant economic factors, such as price reductions due to missed market windows, were not analyzed for this region, as the case for critical use of methyl bromide is sufficiently strong based solely on yield loss.

Economic analysis of Georgia growing conditions included cost and production data representing a second cucurbits or peppers crop.

Maryland and Delaware

In Maryland and Delaware cucurbits, *Fusarium oxypsorum niveum* exists in 3 separate races, and no one crop cultivar has resistance to all races. Crop experts in Maryland report that methyl bromide alternatives provided lower protection against the pathogen while also creating obstacles to meeting premium market windows. USG believes that the situation here is similar to Michigan, in that the best alternatives (1,3 D + chloropicrin) may offer some defense against the pathogen (with a yield loss similar to that likely in Michigan). However, since the crop acreage involved is in low-lying coastal plain, water-logged soils frequently occur in rainy periods and this could delay fumigation with this and other alternatives (such as metam-sodium) and cause additional losses by forcing growers to miss key mid-July market windows.

A determination of the feasibility of methyl bromide alternatives in Maryland and Delaware melon production has not yet been made.

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

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

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

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

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

<u>Renomination Form Part C:</u> 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 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 <u>Appendix I</u> identifying comparative disease ratings and yields with the use of methyl bromide formulations and alternatives.*)

See 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 13 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 were incorporated into the final request. Requests of methyl bromide when the requestor qualified under some other provision (QPS, for example) was also removed and appropriate transition strategies 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 iodomethane. A recent change has been to allow the EUP for iodomethane without the previously required destruction of the crop, thus encouraging more growers to participate in field trials. As with other activities connected with registration of a pesticide, the USG has no legal authority either to compel a registrant to seek an EUP or to require growers to participate.

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

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

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

(i) DESCRIPTION AND IMPLEMENTATION STATUS:

See above.

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

See Section 21.

(iii) IMPACT ON CRITICAL USE NOMINATION/REQUIRED QUANTITIES:

(*For example, provide advice on any reductions to the required quantity resulting from successful progress in technology transfer, scale-up, and/or regulatory approval*.)

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

(iv) ACTIONS TO ADDRESS ANY DELAYS/OBSTACLES:

See above.

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

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

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

(i) DESCRIPTION AND IMPLEMENTATION STATUS:

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

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

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

(iii) ACTIONS TO ADDRESS ANY DELAYS/OBSTACLES:

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

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

(Renomination Form 9.) CHANGES TO TRANSITION PROGRAM

If the transition program outlined in the Party's original nomination has been changed, provide information on the nature of those changes and the reasons for them. Where the changes are significant, attach a full description of the revised transition program.

See Appendix A.

(Renomination Form 10.) OTHER BROADER TRANSITION ACTIVITIES

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

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

Part G: CITATIONS

Allen, L.H., S.J. Locascio, D.W. Dickson, D.J. Mitchell, and S.D. Nelson. 1999. Flooding (soil anoxia) for control of pests of vegetables. Research Summary, USDA Specific Cooperative Agreement 58-6617-6-013.

Ashley, M.G., B.L. Leigh, and L.S. Lloyd. 1963. The action of metham-sodium in soil II. Factors affecting removal of methyl isothiocyanate residues. J. Sci. Food Agric. 14: 153-161.

Burgos, N. R. and R. E. Talbert. 1996. Weed control and sweet corn (*Zea mays* var. *rugosa*) response in a no-till system with cover crops. Weed Sci. 44 (2): 355 – 361.

Chase, C.A., T.R. Sinclair, D.G. Shilling, J.P. Gilreath, and S.J. Locascio. 1998. Light effects on rhizome morphogenesis in nutsedges (Cyperus spp): Implications for control by soil solarization. Weed Sci. 46:575-580.

Culpepper, S. and D. Langston 2001. Fumigant/herbicide combinations in tomato. Unpublished study conducted by researchers at the University of Georgia, Athens, GA. Included in CUE package 03-0042.

Culpepper, S. and D. Langston. 2004. Fumigant/herbicide combinations. Unpublished study conducted by researchers at the University of Georgia, Athens, GA. Included in CUE package 2004.

Csinos, A.S., D.R. Sumner, R.M. McPherson, C. Dowler, C.W. Johnson, and A.W. Johnson. 1999. Alternatives for methyl bromide fumigation of tobacco seed beds, pepper, and tomato seedlings. Proc. Georgia Veg. Conf. Available on the Web at http://www.tifton.uga.edu/veg/Publications/Gfvga99.pdf.

Dowler, C. C. 1999. Herbicide activity of metham, iodomethane, and methyl bromide applied through irrigation systems. Proc. Southern Weed Sci. Soc. 52: 77 – 78.

Dungan, R.S. and S.R. Yates. 2003. Degradation of fumigant Pesticides. 1,3-Dichloropropene, methyl isothiocyanate, and methyl bromide. Vodose Zone Jour. 2: 279-286.

Eger, J. E. 2000. Efficacy of Telone products in Florida crops: a seven year summary. Proc. Annual Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions. Available on the web at http://www.mbao.org/mbrpro00.html.

Galloway, B. A. and L. A. Weston. 1996. Influence of cover crop and herbicide treatment on weed control and yield in no-till sweet corn (*Zea mays* L.) and pumpkin (*Cucurbita maxima* Duch.). Weed Technol. 10 (2): 341 – 346.

Gamliel, A., S. Triki, M. Austerweil, P. DiPrimo, I. Peretz-Alon, O. Heiman, M. Beniches, B.

Steiner, and J. Katan. 2003. Aceelerated degradation of metam sodium in the field and its management. Proc. Annual Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions. Available on the web at http://www.mbao.org/mbrpro03.html.

Gevens, A., and M. K. Hausbeck. 2003. Phytophthora capsici in irrigation water and isolation of *P. capsici* from snap beans in Michigan. Michigan State Univ. Vegetable Crop Advisory Team Alert Vol. 18 (19). Available on the Web at www.ipm.msu.edu/CAT03_veg/V09-24-03.htm.

Gilreath, J., J. P. Jones, and A. J. Overman. 1994. Soil-borne pest control in mulched tomato with alternatives to methyl bromide. Proc. Annual Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions. Available on the web at http://www.mbao.org/mbrpro94.html.

Gilreath, J.P. B.M. Santos, T.M. Motis, J.W. Noling, and J.M. Mirusso. (2005) Methyl bromide alternatives for nematode and *Cyperus* control in bell pepper (*Capsicum annuum*). Crop Prot. 24: 903-908.

Hausbeck, M. K. and B. D. Cortwright. 2004. Evaluation of fumigants for managing *Phytophthora* crown and fruit rot of solanaceous and cucurbit crops, plot two, 2004. Unpublished study supplied with CUE package 04-0005.

Horowitz, M. 1972. Effects of desiccation and submergence on the viability of rhizome fragments of bermudagrass, johnsongrass, and tubers of nutsedge. Israel J. Agric. Res. 22(4):215-220.

Kadir, J. B., R. Charudattan, W. M. Stall, and B. J. Brecke. 2000. Field efficacy of *Dactylaria higginsii* as a bioherbicide for the control of purple nutsedge (*Cyperus rotundus*). Weed Technol. 14 (1): 1 – 6.

Lamour, K.H., and M. K. Hausbeck. 2003. Effect of crop rotation on the survival of *Phytophthora capsici* in Michigan. Plant Disease 87: 841-845.

Larkin, R. P., and Fravel, D. R. 1998. Efficacy of various fungal and bacterial biocontrol organisms for control of *Fusarium* wilt of tomato. Plant Dis. 82:1022 -1028.

Locascio. S. J., and D. W. Dickson. 1998. Metam sodium combined with chloropicrin as an alternative to methyl bromide. Proc. Annual Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions. Available on the web at http://www.mbao.org/mbrpro98.html.

Locascio, S.J., J.P. Gilreath, D.W. Dickson, T.A. Kucharek, J.P. Jones, and J.W. Noling. 1997. Fumigant alternatives to methyl bromide for polyethylene mulched tomato. HortSci. 32: 1208-1211.

Martin, F. N. 2003. Development of alternative strategies for management of soilborne pathogens currently controlled with methyl bromide. Ann. Rev. Phytopathol. 41: 325 - 350.

MBTOC (1994): 1994 Report of the Methyl Bromide Technical Options Committee for the 1995 Assessment of the UNEP Montreal Protocol on Substances that Deplete the Ozone Layer. Nairobi.

Munn. D.A. 1992. "Comparison of shredded newspaper and wheat straw as crop mulches." Hort Technol. 2: 361 - 366.

Noling, J.W., E. Rosskopf, and D.L. Chellemi. 2000. Impacts of alternative fumigants on soil pest control and tomato yield. Proc. Annual Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions. Available on the web at http://www.mbao.org/mbrpro00.html.

Ou, L.-T., K.Y.Chung, J.E. Thomas, T.A. Obreza, and D.W. Dickson.1995. Degradation of 1,3-dichloropropene (1,3-D) in soils with different histories of field applications of 1,3-D. J. Nematol. 25: 249–257.

Phatak, S. C., D. R. Sumner, H. D. Wells, D. K. Bell, and N. C. Glaze. 1983. Biological control of yellow nutsedge, *Cyperus esculentus*, with the indigenous rust fungus *Puccinia canaliculata*. Science. 219: 1446 – 1448.

Patterson, D.T. 1998. Suppression of purple nutsedge (*Cyperus rotundus*) with polyethylene film mulch. Weed Technology, 12:275-280.

Schneider S. M., E.N. Rosskopf, J.G. Leesch, D.O. Chellemi, C. T. Bull, and M. Mazzola. 2003. United States Department of Agriculture – Agricultural Research Service research on alternatives to methyl bromide: pre-plant and post-harvest. Pest Manag Sci. 59: 814-826.

Thullen, R.J. and P.E. Keeley. 1975. Yellow nutsedge sprouting and resprouting potential. Weed Sci. 23:333-337.

Smelt, J.H., S.J.H. Crum, and W. Teinissen. 1989. Accelerated transformation of the fumigant methyl isocyanate in soil after repeated application of metam sodium. J. Environ. Sci. Health B24: 437-455.

UNEP (United Nations Environment Programme). 1998. Methyl Bromide Technical Options Committee (MBTOC) 1998 assessment of alternatives to methyl bromide. p.49.

Verhagen, C., G. Lebbink, and J. Bloem. 1996. Enhanced biodegradation of the nematicides 1,3-dichloropropene and methyl isothiocyanate in a variety of soils. Soil Biol. Biochem. 28:1753–1756.

Webster, T.M. 2002. Nutsedge eradication: impossible dream? National Nursery Proc. RMRS-P-000. USDA Forest Service, Rocky Mtn Res. Station, Ogden, Utah.

Webster, T. M., A. S. Csinos, A. W. Johnson, C. C. Dowler, D. R. Sumner, and R. L. Fery. 2001. Methyl bromide alternatives in a bell pepper – squash rotation. Crop Prot. 20 (7): 605 – 614.

Wilen, C. A., M. E. McGiffen, and C. L. Elmore. 2003. Nutsedge: Integrated Pest Management for Home Gardeners and Landscape Professionals. University of California IPM Publication # 4732. Available on the Web at www.ipm.ucdavis.edu

Zhou, X.G. & K.L. Everts. 2003. Races and Inoculum Density of *Fusarium oxysporum f. sp. niveum* in Commercial Watermelon Fields in Maryland and Delaware. Amer. Phytopath. Soc. V. 87 n. 6 692-698.

APPENDIX A. 2010 METHYL BROMIDE USAGE NEWER NUMERICAL INDEX EXTRACTED (BUNNIE)

2010 Methyl Bromide Usage Newer Numerical Index - BUNNIE — **Cucurbits**

January 23, 2008	Region		Michigan Cucurbit	Mardel Cucurbit	Southeast Cucurbit	Georgia - Squash	Georgia - Cucumber	Georgia - Melon	Sector Total	Notes
Other Considerations	Possible Regime		Metam+Pic	Telone+Pic	Telone+Pic	Telone+Pic	Telone+Pic	Telone+Pic		
Marginal Strategy - Among Best Strategies & Economic Analysis (See Chapter)	Loss Estimate (%) - Yield (Y), Quality (Q), Market Window (M), Time (T)		47% Y + T	29% Y	29% Y	29% Y	29% Y	29% Y		
	Loss per Hectare (US$/ha)		$ 2,232	$ 2,883	$ 2,883	$ 3,510	$ 4,561	$ 3,233		
	Loss per Kg of MeBr (US$/kg)		$ 46	$ 19	$ 19	$ 23	$ 30	$ 22		
	Loss as a % of Gross Revenue		12%	23%	23%	11%	13%	12%		
	Loss as a % of Net Op Revenue		55%	70%	70%	30%	69%	35%		
Dichotomous Variables (Y/N)	Strip or Bed Treatment?		Strip	Strip	Strip	Strip	Strip	Strip		
	Currently Use Alternatives?		Yes	Yes	Yes	Yes	Yes	Yes		
	Tarps / Deep Injection Used?		Tarp	Tarp	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	1x per year		
	Change in CUE Request		increase	new	increase	same	same	same	increase	
Most Likely Combined Impacts (%)	Florida Telone Restrictions	%	0%	0%	0%	8%	8%	8%		
	100 ft Buffer Zones	%	0%	0%	0%	0%	0%	0%		
	Key Pest Distribution	%	100%	100%	60%	60%	56%	63%		
	Regulatory Issues	%	0%	0%	0%	0%	0%	0%		
	Unsuitable Terrain	%	0%	0%	0%	0%	0%	0%		
	Cold Soil Temperature	%	100%	0%	0%	0%	0%	0%		
	Total Combined Impacts	**%**	**100%**	**100%**	**60%**	**63%**	**60%**	66%		
Most Likely Baseline Transition	(%) Able to Transition		0%	0%	32%	33%	37%	24%		
	Minimum # of Years Required		0	0	7	7	7	7		
	(%) Able to Transition / Year		**0%**	**0%**	**5%**	**5%**	**5%**	**3%**		
Joint Adjusted Use Rate		kg/ha	**150**	**150**	**167**	**167**	**165**	**168**		*
Joint Adjusted Dosage Rate		g/m2	15.0	15.0	16.7	16.7	16.5	16.8		
2010 US CUE Application Information	*Amount - Pounds*	*Pounds*	*72,000*	*20,100*	*2,318,200*	*204,752*	*148,204*	*541,896*	*3,305,152*	
	Area - Acres		*673*	*1,000*	*17,300*	*1,528*	*1,106*	*4,044*	*25,651*	
	Rate (lb/A)		*106.98*	*20.10*	*134.00*	*134.00*	*134.00*	*134.00*	*129*	
	Amount - Kilograms	Metric	**32,659**	**9,117**	**1,051,517**	**92,874**	**67,224**	**245,800**	**1,499,191**	
	Treated Area - Hectares		272	405	7,001	618	448	1,637	10,381	
	Rate (kg/ha)		120	23	150	150	150	150	144	
EPA Preliminary Value		**kgs**	**26,592**	**9,117**	**753,688**	**92,874**	**67,224**	**245,739**	**1,195,235**	
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	16,632	9,117	290,504	29,689	22,102	90,774	458,818	*
EPA Transition Amount		kgs	-	-	(80,552)	(8,472)	(6,752)	(22,637)	(118,413)	*
EPA Amount of All Adjustments		kgs	**(9,960)**	**-**	**(543,737)**	**(71,657)**	**(51,874)**	**(177,602)**	**(854,830)**	
Most Likely Impact Value for Treated Area		**kgs**	**16,632**	**9,117**	**209,951**	**21,217**	**15,350**	**68,137**	**340,405**	*
		ha	**111**	**61**	**1,260**	**127**	**93**	**406**	**2,058**	
		Rate	**150**	**150**	**167**	**167**	**165**	**168**	**165**	*
Sector Research Amount (kgs)				**-**	**2010 Total US Sector Nomination**			**340,405**		*