METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE FOR TOMATO GROWN IN OPEN FIELDS

FOR ADMINISTRATIVE PURPOSES ONLY:
DATE RECEIVED BY OZONE SECRETARIAT:
YEAR: ***CUN:***

NOMINATING PARTY:	The United States of America
BRIEF DESCRIPTIVE TITLE OF NOMINATION:	Methyl Bromide Critical Use Nomination for Pre-plant Soil Use for Tomato Grown in Open Fields (Submitted in 2006 for 2008 Use Season)

NOMINATING PARTY CONTACT DETAILS

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Following the requirements of Decision IX/6 paragraph (a)(1), the United States of America has determined that the specific use detailed in this Critical Use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption.

☐ Yes ☐ No

Signature _____ Name _____ Date _____

Title: _____

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

List all paper and electronic documents submitted by the Nominating Party to the Ozone Secretariat

1. PAPER DOCUMENTS: Title of Paper Documents and Appendices	Number of Pages	Date Sent to Ozone Secretariat

2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: Title of Electronic Files	Size of File (kb)	Date Sent to Ozone Secretariat

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PART A: SUMMARY

1. NOMINATING PARTY:

The United States of America (U.S.)

2. DESCRIPTIVE TITLE OF NOMINATION:

Methyl Bromide Critical Use Nomination for Pre-plant Soil Use for Tomato Grown in Open Fields (Submitted in 2006 for 2008 Use Season).

3. CROP AND SUMMARY OF CROP SYSTEM

Tomato Crops Grown in Open Fields for Fruit. In California, Michigan and South-Eastern United States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee). These crops are grown in open fields on plastic tarps, often followed by various other crops. Harvested fruit is destined for the fresh market**.**

4. METHYL BROMIDE NOMINATED:

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)*	NOMINATION AREA (HA)
2008	**1,840,100**	**14,131**

** Includes research amount*

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

Currently registered alternatives to methyl bromide do not consistently provide effective control of nutsedge weed species and more time is needed to evaluate relationship between fumigant alternatives, various mulches, and herbicide systems under different growing conditions.

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

- pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in tomato production.
- geographic distribution of key target pests: i.e., some alternatives may be comparable to methyl bromide as long as key pests occur at low pressure, and in such cases the US is only nominating a CUE for tomato where the key pest pressure is moderate to high such as nutsedge in the Southeastern US.
- regulatory constraints: e.g., telone use is limited in California due to townships caps and in Florida due to the presence of karst geology.
- delay in planting and harvesting: e.g., the plant-back interval for telone+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.

Delays in planting and harvesting result in users missing key market windows, and adversely affect revenues through lower prices.

- unsuitable topography: e.g., alternatives that must be applied with drip irrigation may not be suitable in areas with rolling or sloped topography due to uneven distribution of the fumigant.

TABLE A.1: EXECUTIVE SUMMARY FOR TOMATOES *

Region	*Michigan*	*Virginia*	*Southeast U.S***	*Georgia*	*Florida – North Florida*	*Florida – Ruskin / Palmetto*	*Florida – Palm Beach*	*Florida - Southwest*	*Florida – Dade County*
AMOUNT OF APPLICANT REQUEST									
2008 Kilograms	30,391	453,592	1,038,145	353,443	253,717	845,654	392,652	1,212,587	221,058
AMOUNT OF NOMINATION*									
2008 Kilograms	30,310	91,628	377,955	147,366	98,222	327,373	152,396	473,253	136,097

**See Appendix A for complete description of how the nominated amount was calculated.*
***Includes Alabama, Arkansas, Kentucky, Louisiana, North Carolina, South Carolina, and Tennessee.*

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

Research results confirm that methyl bromide alternatives options provide inconsistent control of nutsedge weed species. Nutsedge is an extremely competitive weed in tomato and can cause significant yield losses in the Southeast. Methyl bromide alternatives also provide incomplete control of soil pathogens in Michigan.

In addition, there is a regulatory prohibition on the use of 1,3-D on karst geology in the South-Eastern United States, including Florida. In Michigan, 1,3-D can only be used when soil temperature are higher than required for using methyl bromide, and this results in a planting/harvesting/marketing delay. In California, alternatives that must be applied with drip irrigation may not be suitable in areas with rolling or sloped topography due to uneven distribution of the fumigant**.**

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

TABLE 7.1: PROPORTION OF CROPS GROWN USING METHYL BROMIDE

REGION WHERE METHYL BROMIDE USE IS REQUESTED	TOTAL CROP AREA AVERAGE OF 2001 AND 2003 (HA)	PROPORTION OF REQUEST FOR METHYL BROMIDE IN 2003 (%)
Michigan Region	769	33
South-Eastern United States	28,646	100
NATIONAL TOTAL : *	51,506	57

* National total includes other regions not requesting methyl bromide
***Includes Alabama, Arkansas, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, and Virginia.*

7. (*ii*) IF ONLY PART OF THE CROP AREA IS TREATED WITH METHYL BROMIDE, INDICATE THE REASON WHY METHYL BROMIDE IS NOT USED IN THE OTHER AREA, AND IDENTIFY WHAT ALTERNATIVE STRATEGIES ARE USED TO CONTROL THE TARGET PATHOGENS AND WEEDS WITHOUT METHYL BROMIDE THERE.

The primary reason that some tomatoes may be grown without methyl bromide in all three regions is the absence of key target pests (i.e., nutsedge in the Southeast, soil pathogens in Michigan, and pathogens and nematodes in California).

In Florida, areas without karst geology and having low nutsedge pressure can successfully employ a fumigation system relying on 1,3-D and chloropicrin.

In Michigan, the majority of tomato producing acres do not have *Phytopthora spp*., and do not use methyl bromide.

In California, areas with flat terrain successfully employ 1,3-D with chloropicrin as a fumigant.

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

No, areas that use methyl bromide do so because hilly terrain, cold soil temperatures, and heavy pest pressure preclude the use of fumigants that are employed when these conditions are not present.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

TABLE 8.1: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE – MICHIGAN, SOUTHEAST U.S., AND GEORGIA

REGION:	***Michigan***	***Southeast U.S*****	***Georgia***
YEAR OF EXEMPTION REQUEST			
KILOGRAMS OF METHYL BROMIDE	30,391	1,491,737	353,443
USE: BROADCAST OR STRIP/BED TREATMENT	Strip/Bed	Mostly Strip/Bed	Mostly Strip/Bed
FORMULATION *(ratio of methyl bromide/chloropicrin mixture)* TO BE USED FOR THE CUE	67/33	Mostly 67/33	Mostly 67/33
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	253	9,534	2,353
DOSAGE RATE* *(g/m^2)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	12.0	16.2	15.0

**Only 36.7% percent of an hectare receives this amount of methyl bromide formulation*
***Includes Alabama, Arkansas, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, and Virginia.*

TABLE 8.2: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE – FLORIDA

REGION:	***Florida – North Florida***	***Florida – Ruskin / Palmetto***	***Florida – Palm Beach***	***Florida - Southwest***	***Florida – Dade County***
YEAR OF EXEMPTION REQUEST	**2008**				
KILOGRAMS OF METHYL BROMIDE	253,717	845,654	392,652	1,212,587	221,058
USE: BROADCAST OR STRIP/BED TREATMENT	Mostly Strip/Bed	Mostly Strip/Bed	Mostly Strip/Bed	Mostly Strip/Bed	Mostly Strip/Bed
FORMULATION *(ratio of methyl bromide/chloropicrin mixture)* TO BE USED FOR THE CUE	Mostly 67/33	Mostly 67/33	Mostly 67/33	Mostly 67/33	Mostly 67/33
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	1,509	5,030	2,335	7,212	1,315
DOSAGE RATE* *(g/m^2)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	16.8	16.8	16.8	16.8	16.8

**Only 36.7% percent of a hectare receives this amount of methyl bromide formulation*

9. SUMMARIZE ASSUMPTIONS USED TO CALCULATE METHYL BROMIDE QUANTITY NOMINATED FOR EACH REGION:

The amount of methyl bromide nominated by the US 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 three applicants 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 geology, buffer zones, unsuitable terrain, and cold soil temperatures.

MICHIGAN REGION - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

MICHIGAN REGION - TABLE 10.1: KEY DISEASES AND WEEDS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY DISEASE(S) AND WEED(S) TO GENUS AND, IF KNOWN, TO SPECIES LEVEL	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
Michigan Region	1. Crown, root and fruit rot caused by *Phytophthora capsici* 2. *Fusarium oxysporum* wilt	MB is currently the only product that can control these soil-borne pathogens and allow MI growers to deliver their produce during premium priced early market windows. Other control measures have plant back restrictions that put MI tomatoes outside the premium priced fresh market. Resistant varieties have not been identified.

MICHIGAN REGION - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

MICHIGAN REGION - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	MICHIGAN REGION
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Transplant tomatoes to produce fruit
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	Squash, cucumber, eggplant and melons. All are susceptible to *Phytpphthora capsici*.
SOIL TYPES: *(Sand, loam, clay, etc.)*	Sandy to Loam
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	Annual
OTHER RELEVANT FACTORS:	Low soil temperatures during late March do not allow effective soil fumigation with telone, telone+ chloropicrin or metam sodium for tomato planting in April.

MICHIGAN REGION - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(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	17.7	20.6	20.9	18.1	8.0	2.4	-2.9	-8.0	-7.0
FUMIGATION SCHEDULE		X										
PLANTING SCHEDULE			X	X								
KEY MARKET WINDOW					X	X	X					

* HAUSBECK AND CORTRIGHT (2003).

** *DATA SOURCE* " http://www.crh.noaa.gov/grr/climate/f6/preliminary.php?site=LAN"

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

In Michigan, low soil temperatures during late March to early April make the use of in-kind (metam-sodium, 1,3-D + chloropicrin) fumigants impractical because soil temperatures may be below the labeled minimums or plant back restrictions may be too long (14 to 30 days) to allow April transplanting of tomato seedlings in the field.

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

MICHIGAN REGION - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	195	233	260	270	256	278
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	100% strip	100% strip	100% strip	100% strip	100% strip	100% strip
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	23,493	28,003	31,235	32,461	30,781	33,430
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	67/33	67/33	67/33	67/33	67/33	67/33
METHOD BY WHICH METHYL BROMIDE APPLIED	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm	Injected 20-25 cm
APPLICATION RATE OF ACTIVE INGREDIENT IN kg/ha*	120	120	120	120	120	120
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	12.0	12.0	12.0	12.0	12.0	12.0

**Only 36.7 percent land area is treated in the form of beds and therefore dosage rate (g/m^2) is higher.*

MICHIGAN REGION - PART C: TECHNICAL VALIDATION

MICHIGAN REGION - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

MICHIGAN REGION – TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE + CITATIONS**	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-D	It is not effective against fungal plant pathogens.	No
Metam sodium	Metam sodium is effective against soil fungi. However, Michigan soil temperatures during April are too low to use this fumigant for an early fresh market tomato crop. Product label states that tomatoes cannot be transplanted to the field for up to 21 days after fumigation. Technically, it is MB alternative, but economically it is not a viable alternative.	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE + CITATIONS**	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Chloropicrin	Chloropicrin is ineffective as a soil fumigant when applied alone.	No
NON CHEMICAL ALTERNATIVES		
Soil solarization	Michigan is a northern state with cold weather conditions and therefore it is not a viable option.	No
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 tomato fields. Any such system would also require large amounts of energy and water to provide sufficient steam necessary to pasteurize soil down to the rooting depth of field crops (at least 20-50 cm).	No
Biological Control	Biological control agents are not technically feasible alternatives to MB because they alone cannot control the soil pathogens and/or nematodes. While biological control may have utility as part of plant pathogen management strategy, it can not be a methyl bromide alternative	No
Cover crops and mulching	There is no evidence that these practices effectively substitute for the control MB provides against fungal pathogens and nematodes.	No
Crop rotation and fallow land	The land is very expensive and there are not enough hectares in tomato growing areas to rotate. The fungal pathogen survive for many years in soil and therefore crop rotation and fallow are not a viable options (Lamour and Hausbeck, 2003*)	No
Endophytes	No information is available on tomato endophytes that will control fungal and plant pathogens.	No
Flooding/Water management	Flooding is not technically feasible because it does not suppress fungal plant pathogens and nematodes.	No
Grafting/resistant rootstock/plant breeding/soilless culture/organic production/substrates/plug plants.	There are no studies documenting the commercial availability of resistant rootstock immune to the fungal pathogens listed as target pests. Grafting and plant breeding are thus also rendered technically infeasible as MB alternatives for control of fungal pathogens and nematodes.	No
COMBINATIONS OF ALTERNATIVES		
Telone + chloropicrin	Telone is effective against nematodes. Chloropicrin is effective against fungal plant pathogens. Their combination is a technically feasible alternative, but Michigan's low soil temperature does not allow soil fumigation during April months for early fresh market tomato crop. See paragraph below.	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE + CITATIONS**	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Metam sodium + crop rotation	Same as for metam sodium.	No

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

The proposal by MBTOC to obviate the use of methyl bromide in Michigan by applying some alternative (specifically a combination of 1,3-D and chloropicrin) in the autumn preceeding crop planting will not work on tomatoes. In Michigan, the predominant agricultural treatment that uses methyl bromide is one where methyl bromide is applied in strips of raised beds. Areas between the raised beds are not treated. In addition to the risk that the harsh winter conditions (prolonged periods of below freezing weather with snow, sleet, and high winds) will tear the plastic barrier, there is significant risk of flooding and concomitant recontamination of the treated areas. The length and severity of the winter means 4-5 months of precipitation is 'stored' in frozen form and released over the short period of thaw in the spring. This thaw-based flooding can be exacerbated by heavy rainfalls (in excess of 25 mm/event) that occur throughout the spring and summer in Michigan. Because phytophthora and verticillium are endemic in the areas of Michigan for which methyl bromide is being requested, flooding will transfer spores from the untreated to treated areas, resulting in additional infected plants and severe crop losses.

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

MICHIGAN REGION – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
None	Other than those options discussed above, there are no alternatives that may control the key pest. Registered fungicides (such as azoxystrobin, mefenoxam and mancozeb) may control aerial infections of *Phytophthora capsici*, but are not effective against crown and root rot phase of this pathogen. Soil fumigation with methyl bromide kills soil-borne primary inoculum of this pest and therefore fungicide use is also reduced (Lamour and Hausbeck, 2003*)

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

MICHIGAN REGION – TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Methyl Iodide	Not registered.	Yes	Unknown
Sodium azide	Not registered. No registration package has been received.	No	Unknown
Furfural	Not registered. Registration package has been received.	Yes	Unknown
Propargyl Bromide	Not registered. No registration package has been received.	No	Unknown
Muscadore albus Strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

MICHIGAN REGION - 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED:

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

This study was repeated during the 2004 growing season. However, this study does not represent the typical Michigan conditions because due to the cool wet weather the plots were not treated until June 8 when the soil was warm enough for the alternatives to be effective. Results show that yields from tomato plots treated with metam potassium (K-Pam), alone or in combination with chloropicrin, and from plots treated with 1,3-D + chloropicrin (Telone C35) are not significantly different from yields from plots treated with MB + chloropicrin or from yields from untreated control plots (Hausbeck and Cartright, 2004). As for the 2003 trial discussed above, results of the 2004 study are still inconclusive, probably because of the occurrence of low pest pressure in the study area.

MICHIGAN REGION – TABLE #? . Evaluation of Fumigants for Managing *Phytophthora* Crown and Fruit Rot of Solanaceous and Cucurbit Crops 2004

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

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

MICHIGAN REGION – TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – KEY PEST 1

No additional information is available.

MICHIGAN REGION – TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
methyl bromide+ chloropicrin	Phytophthora capsici	0.0 – 0.0	0.0
metam sodium	Phytophthora capsici	0.0 – 12.9	12.9
1, 3-D+chloropicrin	Phytophthora capsici	0.0 –6.4	6.4
chloropicrin	Phytophthora capsici	0.0 –6.4	6.4
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS		**0 - 13 % plus revenue losses due to planting delays; Most likely losses are 6 % using 1,3 D + chloropicrin (the best alternative)**	

Reference: Alternatives for methyl bromide on cucurbit and Solanaceous crops, 2003. M.K. Hausbeck, B.D. Cortright. 2003. Unpublished.

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

In Michigan the critical use exemption application states that 1,3-D + chloropicrin, metam-sodium, methyl iodide, sodium azide, and furfural will continue to be under investigation as methyl bromide alternatives. Most of these alternatives are currently unregistered for use on tomato, and there are presently no commercial entities pursuing registration in the United States. The timeline for developing the above-mentioned MB 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 MB 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, black plastic, and foliar fungicides. Use of virtually impermeable film (VIF) will also be investigated as a replacement for the currently used low density polyethylene (LDPE).

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

Tomatoes are grown in fields. In Michigan, it is neither technically feasible nor economically viable to grow tomatoes in soil-less culture or in containers.

MICHIGAN REGION - SUMMARY OF TECHNICAL FEASIBILITY

Although metam sodium and a combination of 1,3-D + chloropicrin can control the key target pest, *Phytophthora,* the resulting planting and harvesting delays due to cold soil temperatures and longer plant-back interval lead to a shorter growing season and missing key market windows when commodity prices are most favorable. These alternatives have plant back restriction that delay tomato harvest by 14-28 days, resulting in lower net revenues per acre because tomato prices decline as season progresses.

Currently unregistered alternatives, such as methyl iodide, sodium azide, propargyl bromide and furfural have good efficacy against the key pests involved. However, even if registration is pursued, the growers will need transition time to adopt them.

SOUTH-EASTERN UNITED STATES - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

SOUTH-EASTERN UNITED STATES - TABLE 10.1: KEY DISEASES AND WEEDS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY DISEASE(S) AND WEED(S) TO GENUS AND, IF KNOWN, TO SPECIES LEVEL	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
South-Eastern United States	Nutsedges (*Cyperus rotundus and C. esculentus*) Root-Knot nematodes *Phytophthora* Crown and Root Rot. *Fusarium* Wilt (*F. oxysporum*)	None of the listed MBTOC alternatives is effective in controlling the key pests in the South-Eastern United States.

SOUTH-EASTERN UNITED STATES - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

SOUTH-EASTERN UNITED STATES - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	SOUTH-EASTERN UNITED STATES
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Transplant for tomato fruit production
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	Tomato. Tomato-Cucumber or Squash or Watermelon or Cantaloupe. Tomato-Cucurbits.
SOIL TYPES: *(Sand, loam, clay, etc.)*	Sandy to loam, over karst geology in many areas
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	Annual
OTHER RELEVANT FACTORS:	No other information provided.

SOUTH-EASTERN UNITED STATES - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(Plant Hardiness Zone)*	6b, 7a, 7b, 8a, 8b, 9b, 10a, 10b											
SOIL TEMP. *(℃)* **	17-20	17-21	21-24	22-26	25-29	26-29	27-30	28-32	27-29	25-27	21-23	19-21
RAINFALL *(mm)**	51-203	51-203	51-203	51-203	102-203	102-203	51-203	51-203	25-102	25-102	25-102	25-102
OUTSIDE TEMP. *(℃)**	11-22	16-23	21-25	25-28	26-28	25-28	23-25	17-25	10-22	7-19	7-19	8-19
FUMIGATION SCHEDULE	X	X		X	X	X	X				X	X
PLANTING SCHEDULE	X	X	X		X					X	X	X
KEY MARKET WINDOW		X	X	X	X	X	X	X	X			

** JACOB (1977). ** FLORIDA SOIL TEMPERATUTES SOURCE IS WWW.IMOK.UFL/EDU/WEATHER/ARCHIVES/200/CLIM00*

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

In the Southeastern U.S., karst geology inhibits the use of all fumigants that contain 1,3-D in a significant portion of the tomato production areas.

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

VIRGINIA - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	1,439	1,719	2,038	2,102	1,983	Not Available