METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE FOR EGGPLANT 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 Preplant Soil Use for Eggplant Grown in Open Fields (Prepared in 2005)

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 Preplant Soil Use for Eggplant Grown in Open Fields (Prepared in 2005)

3. CROP AND SUMMARY OF CROP SYSTEM:

This is a request for eggplant grown in the States of Florida, Georgia, and Michigan. In Florida, eggplant can be grown year-round, and are often double cropped with pepper or cucumber following eggplant harvest. The vegetable crop that follows eggplant in a double cropping production system depends upon prevailing environmental and economic factors. Growers in Florida often put eggplant in as an extra crop, and grow okra, squash, or cucumbers after the eggplant has been harvested. A spring crop of eggplant may follow as a second crop after a fall crop of pepper or tomato. Eggplant does best on well-drained, fertile, sandy-loam soils at a pH of 6.0-6.5. Poorly drained soils may result in slow plant growth, reduced root systems, and low yields. Eggplant requires a long, warm, frost-free growing season, usually of 14-16 weeks. Cold temperatures below 50^{o}C injure this crop. The best temperatures are 27-32^{o}C during the day and 21-32^{o}C during the night. Plant growth is curtailed at temperatures below 16^{o}C. Additionally, soil temperature below 16^{o}C restricts germination. However, most eggplant is started in the field from transplants. Methyl bromide (MB) is always used in the full-bed mulch process. Until 1999, the chemical formulation primarily used was 98 percent methyl bromide and two percent chloropicrin. Since then, growers have shifted to formulations with lower concentrations of methyl bromide and higher amounts of chloropicrin due to the phase-out schedule of methyl bromide (USDA, 2002).

4. METHYL BROMIDE NOMINATED

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)	NOMINATION AREA (HA)
2007	**96,480**	**596**

- This amount includes 433 kg for research.

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

The US nomination is only for those areas where the alternatives are not suitable. In US eggplant 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 eggplant 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 eggplants 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 Florida and Georgia 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.

Methyl bromide is the only fumigant that consistently provides reliable control of target weeds, nematodes, and pathogens. There are no technically or economically feasible alternatives. The best alternatives (e.g. 1,3-D + chloropicrin, metam sodium) are not as effective in controlling nutsedge and have a long waiting period for planting that would disrupt planting schedules and cause growers to miss key market windows. Furthermore, regulatory restrictions due to concerns over human exposure and ground water contamination, along with technical limitations, result in potential economic infeasibility of 1,3-D alone or in combination as a practical MB alternative. Key among these factors are a 28 day planting delay due both to label restrictions, low soil temperatures, and a mandatory 30.4 m buffer for treated fields near inhabited structures.

5.1 Michigan

In Michigan eggplant the key target pest is *Phytophthora capsici*. These soil fungi can easily destroy the entire harvest from affected areas if left uncontrolled. In small plot trials with peppers and cucurbits in Michigan (Hausbeck and Cortright 2004), the level of control provided by 1, 3 D + chloropicrin or metam-potassium was comparable to that afforded by MB. No trials were done with eggplants specifically, but since peppers are also a solanaceous crop, these results are promising. However, it is noteworthy that *P. capsici* has recently been shown to occur in irrigation water in Michigan (Gevens and Hausbeck 2003). This will increase the likelihood of repeated re-infestation of this pathogen. It is also not yet clear whether these small-scale results accurately reflect efficacy of MB alternatives in commercial fresh vegetable (peppers, eggplant, and cucurbit) production. These trials were done at a single location that only had cucurbit crops grown on it in the past, and other studies of these MB alternatives (described in the regional discussions later in this document) have not shown such promising results, suggesting that the pathogen in this Michigan study may not have adapted to solanaceous crops. Perhaps more importantly, this study used fumigants applied in June when soil temperatures are much warmer than in April, which is typically when fumigation must be done by eggplant growers who need to plant according to premium market price windows. Given the lower dissipation of these MB alternatives at temperatures around 4 ^{o}C, it is unlikely that the good efficacy seen in this trial would be consistently repeated if fumigations were timed more typically. Furthermore, regulatory restrictions (e.g., mandatory 30 m buffer zone for treated fields near inhabited structures) due to concerns over human exposure and ground water contamination, along with technical and economic limitations, result in potential infeasibility of this formulation as a practical MB alternative. Also, variations in soil temperatures or rainfall could easily cause delays in fumigation events, since the most likely MB substitutes (1,3 D + chloropicrin and metam-sodium/potassium) currently available have label restrictions or efficacy limitations permitting use only above certain temperatures or when rain is not imminent . Label restrictions on these aMB alternatives also mandate planting delays based on rates used; at higher rates these delays can be as much as 2 weeks longer than those for MB itself. There could thus be unpredictable but potentially significant economic effects created by the planting delays (described above), which will disrupt the schedule of delivery of fresh eggplant harvest to wholesale buyers.

Florida and Georgia

Nutsedges, when present at moderate to severe infestations, are key pests which require MB for control in the Southeastern United States, including Florida and Georgia. Other pest problems in this region that are managed with MB include southern blight, damping-off, and wilt. Of MB alternatives, only 1,3-D + chloropicrin has some efficacy against *Phytophthora.* However, 1,3-D cannot be applied in areas overlying karst geology which is common throughout the Southeast.

Growers in this region also face root-knot nematodes and the fungal pathogens described above as key pests. Left uncontrolled, any of these pests could completely destroy the harvests from affected areas. Halosulfuron, which is effective against nutsedges, can be applied only in row middles, but cannot be applied in raised beds, where nutsedge competition is critical (Florida CUE #03-0054).

Metam-sodium offers erratic, inconsistent control of nutsedges and nematodes, while 1,3-D + chloropicrin provides adequate control of nematodes and diseases (Eger 2000, Noling et al. 2000). However, metam-sodium has yield losses of up to 44 percent compared to MB where weed infestations are moderate to severe (Locascio et al. 1997). Metam-sodium also creates a planting delay as long as 30 days to avoid risk of phytotoxic injury to crops compared to a 14-day delay for MB. Further, due to regulatory restrictions resulting from groundwater contamination concerns, 1,3-D + chloropicrin cannot be used in large portions of the southeastern United States due to the presence of karst geology. There is up to a 28-day planting delay (vs. 14 days for MB) due to regulatory restrictions for 1,3-D + chloropicrin also. Any apparent technical feasibility of metam-sodium and 1,3 D + chloropicrin (and various combinations thereof) are based on small plot research trials that done on crops other than eggplant. For fungi and nutsedge pests at least, no on-farm, large scale trials have yet been done. In a recent small-plot field study conducted in Tifton, Georgia by Culpepper and Langston (2004) on peppers, 1,3-D + chloropicrin, followed by more chloropicrin, was more effective than MB against yellow nutsedge, but less effective against purple nutsedge. Although this treatment performed as well as MB in terms of spring pepper yield, its fall yield performance was inferior to that of MB.

In a second treatment, 1,3-D by itself, followed by chloropicrin, was significantly less effective than methyl bromide for the control of both purple and yellow nutsedge, but as effective as MB for the control soil nematodes. In terms of spring and fall pepper yield, however, this treatment performed as well as MB. In a third treatment, 1,3-D + chloropicrin, followed by metam sodium, was as effective as MB against yellow nutsedge, 36% less effective than MB against purple nutsedge, and as effective as MB for the control of soil nematodes. This treatment also performed as well as MB in terms of both spring and fall pepper yield. It must be noted that nutsedge pressure in this study was relatively low and populations were composed primarily of yellow nutsedge, as opposed to the hardier purple nutsedge. Also, even this promising study did not use eggplants as a test crop system.

Thus, although these MB alternatives show some promise, they will require further testing and larger-scale validation.

Some researchers have also reported that these MB alternatives are degraded more rapidly in areas where they are applied repeatedly due to enhanced metabolism by soil microorganisms. This phenomenon may compromise long-term efficacy of these compounds and appears to need further scientific scrutiny.

In sum, neither of these MB alternatives is presently adequate for control of key pests, and MB remains a critical use for eggplant in the Southeastern United States.

Implications of MB loss for individual growers

If MB were to be removed as a pest control option for U.S. eggplant, the particular growers in each region cited in this nomination would have to stop crop production or suffer substantial losses. These growers would either leave agriculture entirely or switch to other crops that do not rely on pre-plant fumigation for soil pest control. The extent of this impact on the affected growers is debatable, but given the current embryonic state of commercial deployment of MB alternatives, it is possible that growers who currently treat their land routinely with MB would face this outcome.

TABLE A.1: EXECUTIVE SUMMARY FOR EGGPLANT*

Region	*Florida*	*Georgia*	*Michigan*
AMOUNT OF APPLICANT REQUEST			
2007 Kilograms	108,862	48,868	3,799
AMOUNT OF NOMINATION			
2007 Kilograms	69,601	22,647	3,799

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

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

In Florida and Georgia, where weeds, especially nutsedge, are the main methyl bromide target pests neither 1,3-D nor metam sodium, alone or in combination with chloropicrin, adequately control moderate to high nutsedge populations. In Florida and, to a lesser extent in Georgia, the use of 1,3-D is prohibited in areas overlying karst geology because of groundwater contamination concerns. It is estimated that 40% of the Florida's production area overlies karst geology. The 1,3-D label prohibits its use in Dade County, Florida. Moreover, for Florida and Georgia farmers, using products containing 1,3-D and metam sodium in the fall may be impractical because of the required longer waiting periods for planting following application, 28 days for 1,3-D and 21 days for metam sodium, compared to 14 days for methyl bromide. Such delays could cause Florida and Georgia growers to miss part of the key market windows.

In Michigan, where soil-borne pathogens are the key methyl bromide target pests, neither 1,3-D nor metam sodium is effective against soil-borne fungi. Furthermore, the 28 and 21 day planting delays for 1,3-D and metam sodium, respectively, might disrupt this state's carefully-timed planting and harvesting schedules, causing growers to miss part of the market windows. The 1,3-D + chloropicrin combination may be as effective as methyl bromide against soil-borne pathogens. However, the 21-day planting delay would hinder grower adoption of this alternative.

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 2001-2002 AVERAGE (HA)	PROPORTION OF TOTAL CROP AREA TREATED WITH METHYL BROMIDE (%)
Florida	647	100
Georgia	539	60%
Michigan	Not available	Not available
NATIONAL TOTAL*	2197	51

** Includes States not requesting MB*

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.

In Georgia, areas are not treated with MB only when they do not have nutsedges or nematodes naturally present in eggplant fields. Simple absence of all pests is the only reason these areas are not presently treated with MB. In Michigan, areas not treated apparently do not have any infestation (i.e., zero oospores or chlamydospores per unit soil) of the key fungal pests. The applicant states that soil infestation is spreading in the region annually.

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?

Growers have the option to use halosulfuron only in row middles.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

FLORIDA - TABLE 8.1: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION	**FLORIDA**
YEAR OF EXEMPTION REQUEST	**2007**
KILOGRAMS OF METHYL BROMIDE	
USE: FLAT FUMIGATION OR STRIP/BED TREATMENT	Strip Bed
FORMULATION *(ratio of methyl bromide/chloropicrin mixture)* TO BE USED FOR THE CUE	67:33
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	ha
DOSAGE RATE* *(g/m^2)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	16.8

*

GEORGIA - TABLE 8.2: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION	**GEORGIA**
YEAR OF EXEMPTION REQUEST	**2007**
KILOGRAMS OF METHYL BROMIDE	48,868
USE: FLAT FUMIGATION OR STRIP/BED TREATMENT	Predominantly Strip Bed
FORMULATION *(ratio of methyl bromide/Chloropicrin mixture)* TO BE USED FOR THE CUE	67:33
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	325
DOSAGE RATE* *(g/m^2)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	15.0

MICHIGAN - TABLE 8.3: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION	**MICHIGAN**
YEAR OF EXEMPTION REQUEST	**2007**
KILOGRAMS OF METHYL BROMIDE	4,027
USE: FLAT FUMIGATION OR STRIP/BED TREATMENT	Predominantly Strip Bed
FORMULATION *(ratio of methyl bromide/Chloropicrin mixture)* TO BE USED FOR THE CUE	67:33 or 50:50
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	83
DOSAGE RATE* *(g/m^2)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	12.0 Strip treatment

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 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 geology, buffer zones, unsuitable terrain, and cold soil temperatures.

FLORIDA- PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

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

REGION WHERE METHYL BROMIDE USE IS REQUESTED	TARGET PESTS (WEEDS, PLANT-PARASITIC NEMATODES) AND PATHOGENS	SPECIFIC REASONS WHY METHYL BROMIDE IS NEEDED
Florida	Purple and yellow nutsedge (*Cyperus rotundus* & *C. esculentus*), root-knot nematodes (*Meloidogyne* spp.), nightshade (*Solanum* spp.), southern blight (*Sclerotium rolfsii*), white clover (*Trifolium repens*)	Methyl bromide is the only fumigant that consistently controls key target weeds affecting eggplant in Florida. Neither 1,3-D nor metam sodium is effective under high nutsedge population pressures. 1,3-D cannot be applied in areas overlying karst geology (about 40% of the production area in Florida).

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

FLORIDA - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	FLORIDA
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Vegetable crop for fresh market
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)*	Peppers, cucurbits
SOIL TYPES: *(Sand, loam, clay, etc.)*	Sandy and sandy-loam soils
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	Annually
OTHER RELEVANT FACTORS:	Double-cropped with cucurbit; may be preceded by pepper.

FLORIDA - TABLE 11.2: CHARACTERISTICS OF CLIMATE AND EGGPLANT CROP SCHEDULE: NOT DOUBLE-CROPPED

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(e.g. temperate, tropical)*	Zones: 9a, 10a, 10b - In 1997, 80% of the state's eggplant production was in the southeast; remainder of about 20% distributed in the rest of the state, mostly in the central and northern regions.											
RAINFALL *(mm)*	65.5	50.0	72.5	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8
OUTSIDE TEMP.(℃)	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
FUMIGATION SCHEDULE;[A]				X	X	X	X	X	X	X	X	
PLANTING SCHEDULE[B]					**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**
KEY HARVEST WINDOW;[C]	**E**	**E**	**E**	**E**	**E**				**E**	**E**	**E**	**E**

[A]Non-double cropped, earliest start date: June 15.
[B] For Non-Double cropped eggplant production, planting eggplants is usually initiated around July 1; shaded cells represent variation in transplanting dates
[C]For Non-Double Cropped Eggplants; Harvest Period usually begins as early as Nov. 1, may continue until July 31, depending on when planted and weather conditions.

FLORIDA - TABLE 11.3: CHARACTERISTICS OF CLIMATE AND EGGPLANT CROP SCHEDULE; DOUBLE-CROPPED

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE *(e.g. temperate, tropical)*	Zones 9a, 10a, 10b - In 1997, 80% of the state's eggplant production was in the southeast; remainder of about 20% distributed in the rest of the state, mostly in the central and northern regions.											
RAINFALL *(mm)*	65.5	50.0	72.5	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8
OUTSIDE TEMP.(℃)	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
FUMIGATION SCHEDULE[A]				**X**	**X**	**X**	**X**					
PLANTING SCHEDULE[B]					**E**	**E**	**E**	**E**				**2C**
KEY HARVEST WINDOW[F]	**E**	**E**	**2C**	**2C**	**2C**				**E**	**E**	**E**	**E**

[A] Double-cropped; assumed to be with cucurbits; earliest start date is June 15.
[B] For Double-Cropped eggplant production, planting (**E**) is typically initiated on July 1; variance can be until October 1. The second crop of cucurbits transplants would typically be initiated around Feb 1, and may vary until end of Feb, or 1st part of March.
[C] For Double Cropped Eggplants, Harvest Period usually begins as early as Nov. 15 (**E**), may continue until April 15, depending on when planted and weather conditions; Harvesting of second crop (**2C**) may start around May 1 and continue until mid-July

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

The karst geology prevalent in Florida and, to a lesser extent, Georgia severely limits the use of 1,3-D in those States. There are no atypical characteristics identified in the nomination which might prevent the utility of Devrinol™ (napromide) and trifluralin for nutsedge control and for control of broad-leaved weed species, such as morningglory. Halosulfuron, however has several label limitations (e.g., reduced effectiveness if rain events follow within 4 hours of application), and plant-back restrictions (0 to 36 months) (U.S. EPA, CUN 2003/050).

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

FLORIDA - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1998	1999	2000	2001	2002	2003
AREA TREATED *(hectares)*	890	809	728	728	728	647
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	149,723	127,384	114,646	114,623	114,623	101,866
FORMULATIONS OF METHYL BROMIDE *MB /chloropicrin)*	98:2	67:33 or 98:2	67:33 or 98:2	67:33 or 98:2	67:33 or 98:2	67:33 or 98:2
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*						
ACTUAL DOSAGE RATE FOR THE ACTIVE INGREDIENT *(g/m^2)**	16.8	15.7	15.7	15.7	15.7	15.7

FLORIDA - PART C: TECHNICAL VALIDATION

FLORIDA - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

FLORIDA – TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3 –D (Telone™)	Limestone solution channels potentially leading to groundwater (karst geology) underlies a portion of FL production areas. Label restriction states that these products cannot be used where karst geology exists, estimated to be about 40% in 2002 for eggplant area; Telone is not labeled for use in Dade County.	No
Halosulfuron	Registered for use on eggplant (Dec. 2002, US EPA, Aug. 2003); use restricted to the row middle only; potential crop injury; severe plant back restrictions from 3 to 36 months for most vegetables; severe restrictions when used in pest management strategy that includes soil-applied organophosphates.	No
Metam-sodium (Vapam™)	Does not work under high pest pressure. Limited niche as a complementary treatment with other fumigants and herbicides, never stand alone (Noling, 2003). Considered as best available alternative for Dade County only (Aerts, 2003).	No
Napromide (Devrinol™)	Weak in terms of nutsedge efficacy; does not control established weeds (CUE 03-0017); waste of money (Noling, 2003).	No
Trifluralin	Aids in control of annual grasses; does not manage broadleaf weeds. May cause excessive crop stress leading to reductions in stands and yields.	No
NON CHEMICAL ALTERNATIVES		
Solarization	Weed density (yellow and purple nutsedge was greater in the solarized treatments compared to the methyl bromide treatment. Worked for the 1st year in FL peppers; if pest threshold is low (Chellemi, et al., 1997)	No
Myrothecium verrucaria(Ditera™)	Biological nematicide; registered on broad range of crops, field efficacy is untested	No
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin (Telone II or Telone C-35) + Devrinol + trifluralin	Strategy involves applying 1,3-D Flat Fumigation, followed by chloropicrin 3-4 wks post fumigation + both herbicides before laying plastic. Chloropicrin may not be efficacious in managing white mold (*Sclerotium rolfsii*). Producers in Dade County are prohibited from using Telone products.	Yes, except for areas with underlying karst geology.
Solarization + 1,3-D	May work in areas with low weed, pest or disease pressure. Eliminated root galling and high density of root-knot nematodes. (Chellemi, D.O., et al. 1997. Application of soil solarization to Fall Production of cucurbits and pepper. Proc. Fla. State Hort. 110:333-336.)	No
Solarization + biocontrol fungus, *Gliocladium virens*	Ristaino, J.B., Perry, K.B. and R. D. Lumsden. 1996. Soil solarization and Gliocladium virens reduce the incidence of southern blight (*Sclerotium rolfsii*) in bell pepper in the field. Biocon.Sci. and Tech. 6:583-593.	No

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

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

FLORIDA – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
None	Other than options discussed elsewhere, no alternatives exist for the control of the key pests when they are present in the soil and/ or afflict the below ground portions of eggplants.

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

FLORIDA – TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Iodomethane	Pre-plant soil fumigant. Not registered yet.	Yes	Unknown
Trifloxysulfuron sodium	Herbicide. Registration pending ONLY in tomato, FL only. Crop Injury issues exist.	Yes	Unknown
Fosthiazate	OP nematicide. Not registered.	Yes	Unknown
Furfural (Multigard™)	Not registered.	Yes	Unknown
Sodium azide	Not registered. Registration application not yet submitted.	No	Unknown
Propargyl bromide	Not registered. Registration application not yet submitted.	No	Unknown
Paecilomyces lilacinus	Biological nematicide. Registration pending.	Yes	Unknown

FLORIDA - 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:

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

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3 D + chloropicrin	Nutsedges, fungal pathogens	0-40 % (0 % would be possible only in lightly infested areas; these areas are not included in this request for MB)	29 % (Locascio et al., 1997)
Metam-sodium (with or without chloropicrin)	Nutsedges, fungal pathogens	0-66 % (0 % would be possible only in lightly infested areas; these areas are not included in this request for MB)	44 % (Locascio et al., 1997)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**29 % where 1,3 D can be used; 44 % where only metam sodium can be used**

Data (narrative only) and information are bridged for eggplants from the best available information (Locascio et al. 1997).

Locascio et al. (1997) studied MB alternatives on tomatoes grown in small plots at two Florida locations. Various treatments were tested on plots that had multiple pests. At the Bradenton site there was moderate to heavy *Fusarium* infestation; heavy purple nutsedge infestation and light root-knot nematode pressure. At Gainesville there was heavy infestation of yellow and purple nutsedge and moderate infestation of root-knot nematode. The treatments at both locations included MB (67%) + chloropicrin (33%) chisel-injected at 390 kg/ha; metam-sodium (chisel-injected) at 300L/ha; metam-sodium drip-irrigated at 300L/ha; and 1,3-D + 17% chloropicrin chisel-injected at 327L/ha. In pairwise statistical comparisons, the yield was significantly lower in metam-sodium treatments compared to MB at both sites. At Bradenton, the average yield from both metam-sodium treatments was 33% of the MB yields, suggesting a 67% yield loss from not using MB. At Gainesville, the average yield of the two metam-sodium treatments was 56% of the MB yield, suggesting a 44% yield loss from not using MB. The yield of the 1,3-D treatment at Gainesville was 71% of the MB standard suggesting a 29% loss by not using MB (yield data for 1,3-D were not reported for Bradenton). In considering 1,3 D results, one must keep in mind that this MB alternative cannot be used in areas where karst geology exists.

An additional study on some alternative fumigants was performed in 2004 by Culpepper and Langston in Tifton, Georgia. A summary is presented both in the sections discussing Georgia and in the "Summary of technical feasibility" section for Florida (below). While the results were promising, this trial was not used as the basis for yield loss estimates primarily because nutsedge pressure was relatively low and weed populations did not contain many purple nutsedge plants. Reliable control of these weeds (which are arguably hardier than yellow nutsedge) would have to be demonstrated before such a study could be used to revise yield losses.

TABLE 16.1. FUMIGANT ALTERNATIVES TO METHYL BROMIDE FOR POLYETHYLENE-MULCHED TOMATO (LOCASCIO ET AL. 1997)

Chemicals	Rate (/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
MB + 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

***Notes*:** (1) Numbers followed by the same letter (within a column) are not significantly different at the 0.05 level of probability, using Duncan's multiple range test.
(2) Data shown are from the Gainesville/Horticultural Unit site, 1994 season (this was one of three sites included in this study). This site had relatively high nutsedge pressure, and data for both pest pressure and marketable yields for all treatments shown.

Yield loss estimates could likely be lower for growers who can legally use 1,3-D products. For example, evidence from one tomato and bell pepper grower using Telone II on 30 percent of his total area suggests that average yields declined 6.16 % across all fields, while average yield declines were 15.77 % in side-by-side plantings (FFVA, 2002). The standard deviation on these yields did not change, which resulted in an increase in the coefficient of variation from 32.7 percent on fields planted to methyl bromide to 38.3 percent on fields planted to Telone II. These results suggest that alternatives to methyl bromide reduce yields by as much as 15.7 % and that risk associated with yield variability would likewise increase.

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

Iodomethane is under consideration for potential methyl bromide replacement. Although it is currently being considered for registration by regulatory authorities, it is unknown when it will be registered. Please refer to Table 15.1.

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

The U. S. Government is presently unaware of large scale, commercial greenhouse operations for eggplants. It might be expected, however that there are local (or small community) operations of organic eggplant production that target fresh market and/or temporal (seasonal) sectors.

FLORIDA - SUMMARY OF TECHNICAL FEASIBILITY

In Florida neither 1,3-D nor metam sodium, alone or in combination with chloropicrin, adequately control moderate to high nutsedge populations. In addition, 1,3-D cannot be applied in areas overlying karst geology, estimated to be 40% of the production area in the State. Furthermore, using products containing 1,3-D and metam sodium in the fall would mean longer waiting periods for planting following application, 28 days for 1,3-D and 21 days for metam sodium, compared to 14 days for methyl bromide. Such delays may cause Florida growers to miss part of the key market windows.

The top priority of control associated with each major segment of pest management across Florida eggplant production regions remained weeds, especially the nutsedges, because of the lack of registered herbicides that do not cause crop injury, or have severe plant-back restrictions. When nutsedge pressure is moderate to severe, the 1,3-D + chloropicrin combination is not technically feasible because it needs to be coupled with an effective herbicide to provide control for the entire growing season (U.S. EPA, 2002). There are no herbicides which control nutsedge in the crop row. Paraquat and glyphosate will suppress emerged nutsedge, but cannot be used in the crop row because of potential crop injury (SE Pepper Consortium CUE 02-0041).

In the study reported in Item 16 (Table 16.1), 1,3-D + chloropicrin treatments did not adequately control moderate to high nutsedge populations, and yield losses occurred when compared to MB plus chloropicrin treatments. Additional research on this alternative to improve efficacy against nutsedge is needed in areas with moderate to high nutsedge pressure. Lack of an effective, registered herbicide impairs adoption in crops such as eggplant (Banks, 2002).

Culpepper and Langston (2004) recently compared the effectiveness of several soil fumigants in managing soil pests affecting peppers in Tifton, Georgia. Eggplants were not used as a test crop, so here, again, data from peppers are used to "bridge" a discussion. Results show that 1,3-D followed by chloropicrin was significantly less effective than methyl bromide for the control of both purple and yellow nutsedge, but as effective as MB for the control soil nematodes. In terms of spring and fall crop yield, this treatment performed as well as MB. 1,3-D + chloropicrin, followed by more chloropicrin was more effective than MB for the control of yellow nutsedge, but less effective against purple nutsedge. This treatment performed as well as MB in terms of spring crop yield, but poorly in terms of fall yield. 1,3-D + chloropicrin, followed by metam sodium was 36% less effective than methyl bromide for the control of purple nutsedge, but as effective as MB for the control of yellow nutsedge. This combination was as effective as MB against soil nematodes. In terms of spring and fall crop yield, this treatment performed as well as MB. This suggests that these treatments are showing promise and will require further testing and validation in commercial fields. However, it should also be noted that nutsedge populations were relatively low and predominantly composed of yellow nutsedge, which may be easier to control than purple nutsedge.

Diseases caused by soil-borne plant pathogenic fungi, (e.g., *Sclerotinia*, *Phytophthora* spp., *Verticillium* spp., *Pythium* spp. and *Rhizoctonia solani*) may be curtailed if weather conditions are detrimental for disease development. These pathogens commonly reside in many production areas, since many eggplant production areas are old tomato production fields. Fungicides such as chlorothalonil, and azoxystrobilurin are considered to be only prophylactic, and may not offer sufficient pest management. Resistance of *Phytophthora* spp. to metalaxyl and mefenoxam (Ridomil and Ridomil Gold, respectively) has been reported in tomato crop areas, and most recently pepper (Lamour and Hausbeck, 2003).

Nematode pests, such as the root knot nematode species of *Meloidogyne*, were third to weed pests in terms of priority of pest management strategies in Florida eggplant production. Pre-plant control of nematodes is critical since nematode root feeding and damage may predispose plant tissues to invasion by fungal pathogens, potentially leading to wilt, loss of plant vigor, and significant yield losses. Fumigant alternatives such as metam-sodium have proven inconsistent (Noling, 2003; FFVA, 2002).

Approximately 40 percent of the eggplant production area in Florida has karst geology. Because it is illegal for producers to use 1,3-D products (Telone II, Telone C-35) on these soils, growers would likely use a combination of metam-sodium + a herbicide, such as halosulfuron or napropamide.

GEORGIA - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

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

REGION WHERE METHYL BROMIDE USE IS REQUESTED	TARGET PESTS (WEEDS, PLANT-PARASITIC NEMATODES) AND PATHOGENS	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
Georgia	1. Yellow and Purple Nutsedge (*Cyperus esculentus, C. rotundus*) [100%] 2. Crown and Root rot (*Phytophthora capsici*) [40%] 3. Plant-parasitic nematodes (*Meloidogyne incognita; Pratylenchus sp*) [70%] 4. Southern Blight (*Sclerotium rolfsii*) [70%] 5. Pythium root and collar rots (*P. irregulare, P. myriotylum, P. ultimum, P. aphanidermatum*) [100%]	Registered alternatives are not as effective as methyl bromide. Methyl bromide is needed for timely management of targeted pests and pathogens. Using products containing 1,3-D and metam sodium in the fall is impractical because of the long waiting periods for planting following application under plastic mulch. For 1,3-D there is a 28 day waiting period; for metam sodium, there is a 21-day waiting period. Such delays could cause growers to miss part of the higher market windows.

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

GEORGIA - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	GEORGIA
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Vegetable crop for the fresh market
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual; generally 1 year
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	Eggplants, followed by a cucurbit crop (cucumbers, or squash) or pepper.
SOIL TYPES: *(Sand, loam, clay, etc.)*	Sandy loam; clay loam
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	1 time per year; (either in spring or fall)
OTHER RELEVANT FACTORS:	The grower may complete two, three or even four crops in one fumigation cycle.

GEORGIA - 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" *(e.g. temperate, tropical)*	Climate zones 7a, 7b, 8a, and 8b noted in the application. Zone 7a: -15.0 to –17.7 °C (0 to 5 °F): Oklahoma City, OK; South Boston, VA Zone 7b: -12.3 to 14.9 °C (5 to 10 °F); Griffin, GA Zone 8a: -9.5 to -12.2 ° C (10 to 15 °F); Tifton, GA Zone 8b: -6.7 to –9.4 °C (15 to 20 °F); Austin, TX; Gainesville, FL Portions of GA fall into all four of these zones.											
SOIL TEMP. *(℃)*	17.8	22.5	27.1	29.9	31.0	30.4	27.9	23.3	12.2	12.2	10.6	13.1
RAINFALL *(mm)*	127	97	89	114	142	122	86	58	58	114	114	107
AMBIENT TEMP. *(℃)*	21.0	25.4	29.3	31.9	32.6	32.5	30.7	26.3	21.0	17.3	16.4	17.8
FUMIGATION SCHEDULE[A]					▶◀							
PLANTING SCHEDULE[A,B]	⇉⇇				▶◀							
KEY HARVEST (MARKET) WINDOW[A,B]			⇉		⇇			▶	◀			

Shaded areas represent typical duration of activity. Darker shaded areas represent duration of activities for the second crop.

[A] Methyl bromide applied either in the spring or fall allows the grower to economically produce at least two crops (sometimes 3 or 4), the second crop usually cucumbers, from one fumigation event.

[B]Two crops are represented from one fumigation event.

▶= initiation of fumigation or planting and/or harvest of first crop; ◀ = termination of fumigation or planting and/or harvest of first crop. ⇉ = initiation of planting and/or harvest of second crop; ⇇ = termination of planting and/or harvest of second crop.

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

Nearly all of the vegetable production occurs on Coastal Plain Soils, which are subject to high temperatures and excess heat. In addition to weed pests, soil-borne fungal pathogens and plant-parasitic nematodes are endemic to the region and nearly all production areas have severe infestations, thereby necessitating annual treatment with a soil fumigant.

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

GEORGIA - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE ON EGGPLANTS

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1998	1999	2000	2001	2002	2003
AREA TREATED *(hectares)*	168	251	333	315	321	346
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kilograms)*	41,407	47,723	50,023	47,288	48,139	51,968
FORMULATIONS OF METHYL BROMIDE *(e.g. methyl bromide 98:2; methyl bromide /chloropicrin 70:30)*	98:2	98:2 (15% of area) 67:33 (85% of area)	67:33	67:33	67:33	67:33
METHODS BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp	Injected, 20.3 to 30.5 cm, under tarp
ACTUAL DOSAGE RATE FOR THE ACTIVE INGREDIENT *(g/m^2)**	24.7	19.1	15.0	15.0	15.0	15.0

GEORGIA - PART C: TECHNICAL VALIDATION

GEORGIA - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

GEORGIA – 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 products (includes Telone II, Telone EC, & Telone C-35)	Products will not adequately control nutsedge. Label restriction states that these products cannot be used where karst geology exists (~8% of the production area). Up to 2 applications of Telone II, in-line, or EC formulations may be needed to manage moderate to severe pest population levels. Also, there is a 28-day waiting period at the time of application until planting, which could cause loss of over half of the harvest season and the higher-end market windows to be missed. These are plantings made in July and harvested in the fall (Georgia CUE # 03-0049; Kelley, 2003). This only applies to light to moderate infestations and only with Telone C-35.	No
Metam-sodium	Product does not adequately control nutsedge. Also, there is a 21-day waiting period at the time of application until planting (40% of harvest season missed), which may cause part of the higher-end market windows to be missed. These are plantings made in July and harvested in the fall. Beginning the application cycle earlier is not an option, since crops from the previous fumigation cycle must be terminated and cleaned up prior to metam application (Georgia CUE # 03-0049; Kelley, 2003). Repeated applications of MITC (the breakdown product of metam sodium) are known to enhance its biodegradation as a result of adapted microorganisms (Duncan and Yates, 2003).	No
Halosulfuron	Registered for specific uses in eggplant (Dec. 2002, US EPA, Aug. 2003); application for eggplant is for ROW MIDDLE application and would not provide control of nutsedge in the eggplant bed; potential crop injury; severe plant back restrictions from 3 to 36 months for most vegetables.	No
COMBINATIONS OF ALTERNATIVES ---		

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE + CITATIONS**	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
1. 1,3-D products and a herbicide, e.g. napropamide **2**. Metam-sodium and a herbicide, e.g. napropamide **3**. Iodomethane and a herbicide, e.g. napropamide **4**. Glyphosate treatment of plots between the first and second crops (Webster, et al. 2001) **5.** Pest-resistant cultivars combined with alternative fumigant strategies 1, 2, and 3	Currently, there are no data to substantiate transition toward a suitable alternative to annual methyl bromide fumigation. Alternative chemicals and cultural practices that are under consideration include various combinations of currently registered and unregistered fumigants and/or herbicides. Iodomethane is not registered in the U.S. Please refer to Table 15.	No
1,3 dichloropropene followed by chloropicrin	Culpepper and Langston (2004) have tested the effectiveness of several soil fumigant combinations for the management of nutsedges and nematodes affecting peppers in Tifton, Georgia. Results show that 1,3-D followed by chloropicrin was significantly less effective than MB for the control of both purple and yellow nutsedge, but as effective as MB for the control soil nematodes. In terms of spring and fall crop yield, however, this combination performed as well as MB. This treatment is promising and will require further testing and validation in commercial fields.	Yes, except for areas with underlying karst geology
1,3 dichloropropene + chloropicrin (Telone C35) followed by chloropicrin	Culpepper and Langston (2004) have tested the effectiveness of several soil fumigant combinations for the management of nutsedges and nematodes affecting peppers in Tifton, Georgia. In this study, 1,3-D + chloropicrin, followed by more chloropicrin was more effective than MB for the control of yellow nutsedge, but less effective against purple nutsedge. This treatment performed as well as MB in terms of spring crop yield, but poorly in terms of fall yield. This combination does not appear to show promise as a MB alternative.	No
1,3 dichloropropene + chloropicrin (Telone C35) followed by metam sodium	Culpepper and Langston (2004) have tested the effectiveness of several soil fumigant combinations for the management of nutsedges and nematodes affecting peppers in Tifton, Georgia. In this study, 1,3-D + chloropicrin, followed by metam sodium was 36% less effective than MB for the control of purple nutsedge, but as effective as MB for the control of yellow nutsedge and soil nematodes. In terms of spring and fall crop yield, this treatment performed as well as MB. This combination is promising and will require further testing and validation in commercial fields.	No, but shows promise

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

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

GEORGIA – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
None	Other than options discussed elsewhere, no alternatives exist for the control of the key pests when they are present in the soil and/ or afflict the below ground portions of eggplants.

The U.S. EPA only considered those technically feasible registered alternatives which are relevant for managing severe pathogen and pest pressures.
Paraquat and glyphosate will suppress emerged nutsedge, but cannot be used in the crop row because of potential crop injury (SE Pepper Consortium CUE for 2004).

Fumigation of products containing 1,3-D and metam sodium (Vapam and/or K-pam) in the summer or fall is practically impossible because of the waiting periods for planting following application under plastic mulch. For 1,3-D there is a 28-day waiting period; for metam sodium, there is a 21-day waiting period. Such delays may cause reduction in yields and market windows missed. Thus, since the fall crop is dependent upon timely planting, a long waiting period (e.g., 28 days) would cost growers at least half of the harvest season, thereby missing the higher market windows (Kelley, 2003).

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

GEORGIA – TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Iodomethane	Not registered	Yes	Unknown
Fosthiazate	Not registered.	Yes	Unknown
Furfural (Multigard™)	Not registered	Yes	Unknown
Sodium azide	Not registered. Registration application not yet submitted.	No	Unknown
Propargyl bromide	Not registered. Registration application not yet submitted.	No	Unknown
Paecilomyces lilacinus	Not registered. Registration pending.	Yes	Unknown

GEORGIA - 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

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

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3 D + chloropicrin	Nutsedges	0-40 % (0 % would be possible only in lightly infested areas; these areas are not included in this request for MB)	29 % (Locascio et al., 1997)
Metam-sodium (with or without chloropicrin)	Nutsedges	0-66 % (0 % would be possible only in lightly infested areas; these areas are not included in this request for MB)	44 % (Locascio et al., 1997)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**29 % where 1,3 D can be used; 44 % where only metam sodium can be used**

Data (narrative only) and information are bridged for eggplants from the best available information.

Locascio et al. (1997) studied MB alternatives on tomatoes grown in small plots at two Florida locations. Various treatments were tested on plots that had multiple pests (Table 16.1). At the Bradenton site there was moderate to heavy *Fusarium* infestation; heavy purple nutsedge infestation and light root-knot nematode pressure. At Gainesville there was heavy infestation of yellow and purple nutsedge and moderate infestation of root-knot nematode. The treatments at both locations included MB (67%) + chloropicrin (33%) chisel-injected at 390 kg/ha; metam-sodium (chisel-injected) at 300L/ha; metam-sodium drip-irrigated at 300L/ha; and 1,3-D + 17% chloropicrin chisel-injected at 327L/ha. In pairwise statistical comparisons, the yield was significantly lower in metam-sodium treatments compared to MB at both sites. At Bradenton, the average yield from both metam-sodium treatments was 33% of the MB yields, suggesting a 67% yield loss from not using MB. At Gainesville, the average yield of the two metam-sodium treatments was 56% of the MB yield, suggesting a 44% yield loss from not using MB. The yield of the 1,3-D treatment at Gainesville was 71% of the MB standard suggesting a 29% loss by not using MB (yield data for 1,3-D were not reported for Bradenton). In considering 1,3 D results, one must keep in mind that this MB alternative cannot be used in areas where karst geology exists.

An additional study on some alternative fumigants was performed in 2004 by Culpepper and Langston in Tifton, Georgia. A summary is presented in the "Summary of Technical Feasibility" section for Georgia (below). While the results were promising, this trial was not used as the basis for yield loss estimates primarily because nutsedge pressure was relatively low and weed populations did not contain many purple nutsedge plants. Reliable control of these weeds (which are arguably hardier than yellow nutsedge) would have to be demonstrated before such a study could be used to revise yield losses.

TABLE 16.1. FUMIGANT ALTERNATIVES TO METHYL BROMIDE FOR POLYETHYLENE-MULCHED TOMATO (LOCASCIO ET AL. 1997)

Chemicals	Rate (/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
MB + 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

Notes: (1) Numbers followed by the same letter (within a column) are not significantly different at the 0.05 level of probability, using Duncan's multiple range test.

(2) Data shown are from the Gainesville/Horticultural Unit site, 1994 season (this was one of three sites included in this study). This site had relatively high nutsedge pressure, and data for both pest pressure and marketable yields for all treatments shown.

GEORGIA - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?: *(If so, please specify.)*

Iodomethane is under consideration for potential methyl bromide replacement. Although it is currently being considered for registration by regulatory authorities, it is currently unknown when it will be registered. Please refer to Table 15.1.

In addition, the following new long-term studies have been initiated at the Coastal Plain Experiment Station in Tifton, Georgia, with funding provided by USDA-CSREES, Methyl Bromide Transitions Grant:

- Evaluation of the effects of soil conditions, particularly soil temperature and moisture, on nutsedge species efficacy from several fumigants.

- Investigation of the impact of multiple-season adoption of methyl bromide alternatives in terms of pest species composition, including weeds, diseases, and nematodes.

- Integration of multiple tactics as alternatives to methyl bromide for management of weeds, diseases, and nematodes in pepper and eggplant.

- Evaluation of vegetable crop response to herbicides applied under plastic prior to crop transplants and characterize herbicide fate when applied in a plasticulture system between summer and fall crops.

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

No. Any organic production of eggplants is presumed insignificant and probably not cost-effective because of the intensive management of pests (for organic production) and the long growing season.

GEORGIA - SUMMARY OF TECHNICAL FEASIBILITY

Neither 1,3-D nor metam sodium, alone or in combination with chloropicrin, adequately control moderate to high nutsedge populations in Georgia. In addition, 1,3-D cannot be applied in areas overlying karst geology (~ 8 % of the eggplant area; CUE #03-0050). Furthermore, using products containing 1,3-D and metam sodium in the fall is impractical because of the required long waiting periods for planting following application, 28 days for 1,3-D and 21 days for metam sodium. Such delays would cost Georgia farmers at least half of the harvest season, thereby missing key market windows.

In studies on peppers (Csinos et al. 1999, Noling et al. 2000), 1,3-D + chloropicrin treatments did not adequately control moderate to high nutsedge populations, and yield losses occurred when compared to MB plus chloropicrin treatments. Additional research on this alternative to demonstrate efficacy against nutsedge is needed in areas with moderate to high nutsedge pressure, considered to be approximately 58% of the current eggplant production area (Culpepper, 2004). Lack of an effective, registered herbicide impairs adoption in crops such as pepper (Banks, 2002), and probably other high value vegetable crops for the fresh market (Monks, Southeast Peppers Consortium, CUE 03-0041).

Culpepper and Langston (2004) recently compared the effectiveness of several soil fumigants in managing soil pests affecting peppers in Tifton, Georgia. Eggplants were not used as a test crop, so here, again, data from peppers are used to “bridge” a discussion. Results show that 1,3-D followed by chloropicrin was significantly less effective than methyl bromide for the control of both purple and yellow nutsedge, but as effective as MB for the control soil nematodes. In terms of spring and fall crop yield, this treatment performed as well as MB. 1,3-D + chloropicrin, followed by more chloropicrin was more effective than MB for the control of yellow nutsedge, but less effective against purple nutsedge. This treatment performed as well as MB in terms of spring crop yield, but poorly in terms of fall yield. 1,3-D + chloropicrin, followed by metam sodium was 36% less effective than methyl bromide for the control of purple nutsedge, but as effective as MB for the control of yellow nutsedge. This combination was as effective as MB against soil nematodes. In terms of spring and fall crop yield, this treatment performed as well as MB. This suggests that these treatments are showing promise and will require further testing and validation in commercial fields. However, it should also be noted that nutsedge populations were relatively low and predominantly composed of yellow nutsedge, which may be easier to control than purple nutsedge.

Nematode pests, such as the root knot nematode species of *Meloidogyne*, were third to nutsedge and fungal pathogens in terms of priority of pest management strategies in Georgia eggplant production. Pre-plant control of nematodes is critical since nematode root feeding and damage may predispose plant tissues to invasion by fungal pathogens, potentially leading to wilt, loss of plant vigor, and significant yield losses. Fumigant alternatives such as metam-sodium have proven inconsistent (Noling, 2003; FFVA, 2002).

Diseases caused by soil-borne plant pathogenic fungi, (e.g., *Phytophthora* spp., *Pythium* spp. and *Sclerotium rolfsii*) may be curtailed if weather conditions are detrimental for disease development. These pathogens are endemic in many vegetable production areas in Georgia. Fungicides such as chlorothalonil, and azoxystrobilurin are considered to be only prophylactic, and may not offer sufficient pest management. Resistance of *Phytophthora* spp to metalaxyl and mefenoxam (Ridomil and Ridomil Gold, respectively) has been reported in tomato crop areas, and most recently pepper (Lamour and Hausbeck, 2003)

The use of products containing 1,3-D and metam sodium in the fall is impractical because of the long waiting periods for planting following application under plastic mulch. For 1,3-D there is a 28 day waiting period; for metam sodium, there is a 21-day waiting period. Such delays would cost growers at least half of the harvest season, thereby missing the higher market windows. Thus, since the fall crop is dependent upon timely planting, the required waiting period would cost growers at least half of the harvest season, thereby missing the higher market windows (Kelley, 2003).

MICHIGAN - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

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

REGION WHERE METHYL BROMIDE USE IS REQUESTED	TARGET PESTS (WEEDS, PLANT-PARASITIC NEMATODES) AND PATHOGENS	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
Michigan	Crown and root rots caused by Soil-borne Fungus - *Phytophthora capsici*. Wilts caused by Soil-borne Fungi - *Verticillium* spp.	Methyl bromide alone allows growers to fumigate and plant early in order to capture the key market window (July - September) and have their product available for premium prices, as well as ensuring demand for their crop during the entire growing season, especially during the mid and late season. The fumigation and planting schedule allow growers to maintain market diversity, as well.

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

MICHIGAN - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	MICHIGAN
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Vegetable crop for the fresh market
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual -- generally 1 year
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	Rotation sequence commonly followed by a pepper or cucurbit crop
SOIL TYPES: *(Sand, loam, clay, etc.)*	Sandy loam, clayish loam
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	1 time every 2 years
OTHER RELEVANT FACTORS:	Michigan's diversified vegetable crop production is designed to meet key late spring and summer market demands in Midwestern states.

MICHIGAN - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE FOR EGGPLANTS

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE "PLANT HARDINESS ZONE" *(e.g. temperate, tropical)*	Generally characterized as 5b according to the USDA Hardiness Zone Map, with annual minimum temperature ranges (average) as –23.4 to –26.1 °C (-15 to –10 °F). Example cities: Columbia, Missouri and Mansfield, Pennsylvania.											
SOIL TEMP. *(°C)*	<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. *(°C)*	0.2	7.4	12.1	17.5	20.6	20.9	18.1	8	2.4	-2.9	-8	-7
FUMIGATION SCHEDULE		▶-◀										
PLANTING SCHEDULE			▶-◀									
KEY HARVEST (MARKET) WINDOW					▶			◀				

Shaded areas represent typical duration of activity; ▶ = typical initiation of activity, ◀ = typical termination of activity

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

Michigan experiences heavy rainfall events across the entire state at any given moment of the growing season. Heavy rain events (over 25 mm) can trigger rapid root and crown rot development, and promote dissemination of *Phytophthora capsici* via irrigation sources. Generally, there is no difference in the amount of infection depending on soil type or production area. The pathogen is widespread and indigenous on almost all soil types in Michigan (Cortwright, 2003; Gevens and Hausbeck, 2003).

All fumigation practices need to be completed by the first week of May to allow growers to plant early and capture the early market (July-September).

Significant rainfall events (>25.4 mm) or cold soil temperatures (<4.4 °C) could delay fumigation and planting. Such cold soil temperatures often occur in early spring (March – April) in this region (Schaetzl and Tomczak 2001).

Lighter soil types may make drip application difficult (Cortright, 2003).

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

Michigan's use of methyl bromide for vegetable production has declined steadily since the mid-1990s, when growers switched to different application methods (i.e. from Flat Fumigation to tarped beds) and formulations, from 98:2 to 67:33 (methyl bromide:chloropicrin). Since 1997, all methyl bromide is applied to tarped beds, with 100% of low density polyethylene sheeting and 95% of the area was treated with the 67:33 formulation. Since 2000, about 5% of the area used the 50:50 methyl bromide:chloropicrin formulation. Growers are using anti-drip valves to eliminate loss of MB at the end of rows when the machinery is removed from the ground.

Please see Table 12.1 for further information.

MICHIGAN - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1998	1999	2000	2001	2002	2003
AREA TREATED *(hectares)*	24	25	29	33	34	32
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	2,870	2,937	3,500	3,905	4,057	3,846
FORMULATIONS OF METHYL BROMIDE *(e.g. methyl bromide 98:2; methyl bromide/Chloropicrin 70:30)*	67:33	67:33	67:33 or 50:50	67:33 or 50:50	67:33 or 50:50	67:33 or 50:50
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	Injected 20-25 cm strip treatment	Injected 20-25 cm strip treatment	Injected 20-25 cm strip treatment	Injected 20-25 cm strip treatment	Injected 20-25 cm strip treatment	Injected 20-25 cm strip treatment
ACTUAL DOSAGE RATE FOR THE ACTIVE INGREDIENT *(g/m^2)* *****	12.0	12.0	12.0 or 9.0	12.0 or 9.0	12.0 or 9.0	12.0 or 9.0

MICHIGAN - PART C: TECHNICAL VALIDATION

MICHIGAN - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

MICHIGAN – 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-Dichloropropene (1,3-D)	Not effective against soil-borne fungi. Several bacteria genera appear to be capable of degrading 1,3-D (Duncan and Yates, 2003). There is a Federal label restriction of a 30.4 m buffer zone between treated fields and inhabited structures. 28-day waiting period for planting may be disruptive to timely eggplant production and marketing.	No
Chloropicrin	Does not distribute evenly throughout the soil profile when used by itself, resulting in poor efficacy. Does not control *Phytophthora capsici* when used at maximum label rates. (California Pepper Commission, CUE 02-0017; CUE03-0017)	No
Metam Sodium (or metam potassium)	Poor fumigant with erratic results and inconsistent distribution in soil profiles; does not control *Phytophthora capsici* nor *Verticillium* spp. (California Pepper Commission, CUE 02-0017; CUE03-0017). Repeated applications of MITC (the breakdown product of metam sodium) are known to enhance its biodegradation as a result of adapted microorganisms (Duncan and Yates, 2003). Phytotoxicity has been reported with this fumigant. 21-day day waiting period for planting may be disruptive to timely eggplant production and marketing. In a recent study conducted in Oceana County, Michigan by Hausbeck and Cortright (2004), yields from pepper plots treated with metam potassium (K-Pam) were comparable to yields from control plots and plots treated with MB + chloropicrin. Eggplants were not studied. These results, while promising, seem to indicate a very low pest (*P. capsici*) pressure at the test site, and require further validation.	No
COMBINATIONS OF ALTERNATIVES		
1,3-D + chloropicrin (Telone C-35)	The 28-day waiting period for planting could disrupt the eggplant production and marketing timing. Regulatory restrictions due to concerns over human exposure and ground water contamination, along with technical limitations, result in potential economic infeasibility of this formulation as a practical MB alternative. In a recent study conducted in Oceana County, Michigan by Hausbeck and Cortright (2004), yields from pepper plots treated with 1,3-D+chloropicrin were comparable to yields from control plots and plots treated with MB + chloropicrin. Eggplants were not studied. These results, while promising, seem to indicate a very low pest (*P. capsici*) pressure at the test site, and require further validation.	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	Metam sodium is a poor fumigant that provides erratic control. Repeated applications of MITC (the breakdown product of metam sodium) are known to enhance its biodegradation as a result of adapted microorganisms (Duncan and Yates, 2003). Because of high land costs, very few crops are of high enough economic value to be rotated with eggplants. A 4-5 year rotation is necessary to reduce inoculum levels. The economic threshold of *Phytophthora capsici* is presumed to be 1 oospore/ft^2 (Michigan CUE 03-0061). 21-day day waiting period for planting may be disruptive to timely eggplant production and marketing.	No
Metam Sodium/Furfural (Multigard™)	Results of a 2003 small plot field study demonstrated practically equivalent soil pest control of targeted pests (plot vigor) and slightly lesser yields than methyl bromide. (Cortwright and Hausbeck, 2004). Please refer to Table 16.2 for this region. Although furfural is not yet registered by the U.S.EPA, it is under consideration by federal authorities.	Insufficient data and trials to estimate cost-effectiveness at this time.

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

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

Potential yield losses to *Phytophthora capsici* could be up to 10% of the production area, especially if the plants are affected early in the growing season. This is explained by the widespread occurrence of indigenous populations of *P. capsici*, (Michigan CUE #03-0061; Gevens and Hausbeck., 2003), significant rainfall events (greater than 254 mm) which trigger rapid disease development (Cortwright, 2003), metalaxyl and mefenoxam-insensitivity reported among *Phytophthora* spp. populations in several vegetable production areas (Lamour and Hausebeck, 2003; Parra and Ristaino, 1998), and planting restrictions of registered alternative fumigants (e.g. 1,3-D + chloropicrin and metam-sodium).

Wilts caused by species of soil-borne fungi such as *Verticillium* are endemic to many vegetable-producing areas of Michigan. These fungi have an extensive plant host range, typically forming survival structures (microsclerotia) which are resistant to fungicides and periods of drought, overwintering in colonized plant tissue.

Planting restrictions on 1,3-D and metam-sodium labels also limit Michigan grower use of these fumigants. Potential yield losses associated with regulatory restrictions could be higher because fumigation needs to be completed by the first week of May to allow growers to plant early and capture the early market (July - September) and have their product available for premium prices, as well as ensuring demand for their crop during the entire growing season (especially during the mid and late season). According to the applicant, Michigan's diversified vegetable crop industry, designed to meet market demands in the late spring and through the summer for Midwestern markets, require carefully-timed planting and harvesting schedules. The fumigation with methyl bromide and planting schedule allow growers to maintain market diversity, as well. Fumigation with 1,3-D + chloropicrin might be an effective alternative, except in certain years when climatic conditions (e.g., wet soils) may delay planting schedules.

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

MICHIGAN – TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Iodomethane	Not registered.	Yes	unknown
Fosthiazate	OP nematicide. Under review.	Yes	Unknown
Furfural (Multigard™)	Not registered.	Yes	Unknown
Sodium azide	Not registered.	Yes	Unknown
Diallyl sulfide	Registered to control *Sclerotinia* spp. (plant-pathogenic fungi). Very limited and narrow spectrum of uses.	Uses may be expanded	Unknown
Metam sodium	Registered	Yes	Reregistration scheduled for 2005-06
Propargyl bromide	Not registered.	Yes	Unknown
Paecilomyces lilacinus	Not registered. Registration pending.	Yes	Unknown

MICHIGAN - 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:

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

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3 D + Chloropicrin	Soil borne fungal diseases	5-95 % PLUS loss of revenue due to planting delays	6 % PLUS loss of revenue due to planting delays (Hausbeck and Cortwright, 2003)
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**6 % likely with the best alternative (1,3 D + chloropicrin)**

Small plot field trial conducted in summer, 2003: Evaluation of fumigants for managing *Phytophthora* crown and fruit rot of solanaceous and cucurbit crops. The following are the results of the eggplant trials (Cortrright and Hausbeck, 2004).

In a randomized complete block design with 4 replicates per treatment, no significant differences were noted for eggplant yields for plots treated with metam sodium (Vapam), methyl bromide + chloropicrin, 1,3-D + chloropicrin or Iodomethane (Midas™)+ chloropicrin. Eggplant yields obtained from plots treated with the 50% formulation of iodomethane + chloropicrin were practically equivalent, whereas eggplant yields from plots treated with the 33% formulation of iodomethane + pic were appreciably higher than yields from plots treated with MB. The vegetable plots (portion of relevant results in Table 16.2) were constructed on a sandy loam soil (72.4% sand, 14.2% silt, 13.4% clay) with a known history of *Phytophthora,* and pumpkin planting in 2002, followed by a rye cover crop. Fumigant treatments were injected at 80 psi; all treatment beds were covered with 1.25-mil black-plastic embossed mulch. Beds were 6 in. high and spaced 5 ft apart. Two drip tubes were installed just under the plastic during bed formation and mulch laying, dividing the bed into thirds. During the first week of August, 2003, several heavy rain events saturated the soil (101-262 mm during a span of 3 days, Oceana, MI). While the good yields were promising results, it is not clear if *Phytophthora* pressure was typical of what would be observed in fields routinely planted with eggplants; the test plots had only been used for cucurbit crops before the trial, and cucurbit crops (but not pepper crops) grown alongside showed significant yield losses in treatments using MB alternatives. Furthermore, given the less promising results observed by other researchers (Locascio and Dickson 1998, Csinos et al. 1999), larger scale and multiple year studies remain necessary before the use of MB alternatives can be unequivocally relied upon.

Table 16.2 Summary of field trials conducted by Cortright and Hausbeck (2004)

ALTERNATIVE	APPLICATION RATE, METHOD	TARGET PEST(S)[A]	YIELDS OF EGGPLANTS (numbers of fruit)
Untreated		*Phytophthora capsici* *Verticillium* spp.	14.3
Multigard™ Protect + metam-sodium HL Multigard™	37 gal + 20 gal Preplant Drip 5.8 gal Postplant Drip		14.4
Multigard™ Protect + metam sodium HL Multigard™	56 gal + 30 gal Preplant Drip 5.8 gal Postplant Drip		13.1
Metam-sodium HL	75 gal; Preplant Drip		10.5
MB + chloropicrin (67:33)	350 lb; Preplant Shank		16.2
1,3-D + chloropicrin C35	35 gal; Preplant Shank		17.0
Iodomethane/chloropicrin (50:50)	250 lb; Preplant Shank		13.3
Iodomethane/chloropicrin (33/67)	200 lb; Preplant Shank		23.9

[A]Other pests (e.g., weeds and nematodes) were most likely present; however population densities were not determined in this study. Ratings of plant health and severe disease pressure were based on typical symptoms of Phytopthora crown and fruit rots on peppers

From these small plot studies, the yield results indicate that 1,3-D + chloropicrin (65:35 formulation) and methyl bromide (67:33) were very effective in managing pest populations for eggplants. Yields of eggplants were appreciably higher in the plots treated with the 33/67 iodomethane/chloropicrin (~66 lbs iodomethane formulation, however eggplant yields were practically equivalent in the higher rate of iodomethane (50:50 formulation; 125 lbs iodomethane). However, yields of eggplants from the metam-sodium-treated plots were somewhat lower than for the plots treated with methyl-bromide, demonstrating the inconsistency of metam-sodium in pesticidal efficacy. Multigard™ (furfural) applied post-plant seemed to slightly improve eggplant yield compared to metam-sodium alone. Yields were lower than those obtained with methyl bromide, however. Soils treated with repeated applications of metam-sodium (or metam-potassium) are known to enhance its biodegradation through adapted microorganisms. Preliminary evidence suggests that the microorganisms responsible for enhanced degradation of MITC specifically target the isothiocyanate functional group (Duncan and Yates, 2003). Other field researchers have alluded to metam-sodium's limited niche as a complementary treatment with other fumigants and herbicides, indicating that this chemical should not be used as a stand-alone treatment (Noling, 2003).

At present, no data directly attribute yield losses to alternative management of pest pressures. Results of the above small study also suggest that yield losses can be mitigated if careful attention is given to pre-plant fumigation methods and bed preparation. Efficacy depends on proper application and can vary from site to site. In a similar trial, conducted in another Michigan location, with a lighter soil type, lower disease pressure was reported. However the lighter soil type reportedly made drip application difficult. (Cortwright, 2003).

Expert opinion in the production area, U.S. EPA analyses (August, 2003), and nomination packages (CUE#s 02-0017-California & 03-0017-Florida) provide a yield loss range of 8 to 15%, depending on the extent of pathogen infestation, location of the fields and weather or climatic conditions that favor disease development. In some years, yield losses can be much greater.

An upper bound of 6% yield loss (for high pest pressures only) is estimated because of 100% field infestation with the soil-borne fungus, *Phytophthora capsici*. Chloropicrin does not provide control of *Phytophthora capsici* or other soil pathogens, such as *Verticillium* spp. Since metalaxyl-resistant strains of *Phytophthora capsici* have been documented on solanaceous crops (Lamour and Hausbeck, 2003; Parra and Ristaino, 1998), growers do not rely on Ridomil™, Ridomil Gold™, or Quadris™.

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

Iodomethane is under consideration for potential methyl bromide replacement. Date of registration is not known.

Please refer to Table 15.1 for a listing of other alternatives, currently under consideration and/or registration status, as of December, 2003.

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

The Agency is presently unaware of large scale, commercial greenhouse operations for eggplants. It might be expected, however that there are local (or small community) operations of both organic and hothouse eggplant production that target fresh market, and/or temporal (seasonal) sectors, e.g., farmers' markets. Large-scale production is probably not cost-effective, because of the intensive management of pests and the long growing season for eggplants.

MICHIGAN - SUMMARY OF TECHNICAL FEASIBILITY

Results depicted in Table 16.1 suggest practically equivalent pest management at the pre-plant stage (plant vigor ratings) and harvestable eggplant yields from plots treated with 1,3-D + chloropicrin. However, yields of eggplants from the metam-sodium-treated plots were somewhat lower than for the plots treated with MB, demonstrating the inconsistency of metam-sodium in pesticide efficacy. Multigard™ (furfural) applied post-plant seemed to slightly improve eggplant yield, than with metam-sodium alone. Yields were lower than those obtained with methyl bromide, however. Soils treated with repeated applications of metam-sodium (or metam-potassium) are known to enhance their biodegradation as a result of adapted microorganisms. Preliminary evidence suggests that the microorganisms responsible for enhanced degradation of MITC specifically target the isothiocyanate functional group (Duncan and Yates, 2003). Other field researchers have alluded to metam-sodium's limited niche as a complementary treatment with other fumigants and herbicides, and this chemical should never be used as a stand-alone treatment (Noling, 2003).

It should be noted that, these plots were carefully monitored and managed; post-plant prophylactic foliar fungicide (chlorothalonil, myclobutanil, Cabrio™) and herbicide treatments were necessary to manage and prevent seasonal fluctuations of pest pressures.

Diseases caused by soil-borne plant pathogenic fungi, (e.g., *Phytophthora* spp., *Verticillium* spp., *Pythium* spp. and *Rhizoctonia solani*) may be curtailed if weather conditions are detrimental for disease development. These pathogens are indigenous in many vegetable production areas in Michigan. Fungicides such as chlorothalonil, and azoxystrobilurin are considered to be only prophylactic, and may not offer sufficient pest management. Resistance of *Phytophthora* spp to metalaxyl and mefenoxam (Ridomil and Ridomil Gold, respectively) has been reported in tomato crop areas, and most recently pepper (Lamour and Hausbeck, 2003).

Rather than lack of effective alternative fumigants, planting restrictions on the labels of 1,3-D and metam-sodium prevent their adoption by Michigan growers. Michigan's diversified vegetable crop production practices are designed to meet key late spring and summer market demands in Midwestern states in a timely fashion. Fumigation practices need to be completed by the first week of May to allow growers to plant early and capture the early market (July - September) and have their product available for premium prices, as well as ensuring demand for their crop during the entire growing season (especially during the mid and late season). The fumigation with methyl bromide and planting schedule allow growers to maintain market diversity, as well. Fumigation with 1,3-D + chloropicrin might be an effective alternative, except in certain years or climatic conditions (e.g., wet soils) which may delay planting schedules.

PART D: EMISSION CONTROL

19. TECHNIQUES THAT HAVE AND WILL BE USED TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS IN THE PARTICULAR USE:

TABLE 19.1: TECHNIQUES TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS

TECHNIQUE OR STEP TAKEN	VIF OR HIGH BARRIER FILMS	METHYL BROMIDE DOSAGE REDUCTION	INCREASED % CHLOROPICRIN IN METHYL BROMIDE FORMULATION	LESS FREQUENT APPLICATION
WHAT USE/EMISSION REDUCTION METHODS ARE PRESENTLY ADOPTED?	Currently some growers use HDPE tarps.	Growers have switched from a 98% MB formulation to a 67 % formulation. Between 1997 and 2001, the US has achieved a 36 % reduction in use rates.	From 2 % to 33 %	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 % MB formulation in Michigan commercial production systems. Not known if other regions are planning similar work.	Research is underway to develop use of a 50 % MB formulation in Michigan commercial production systems. Not known if other regions are planning similar work.	The US anticipates that the decreasing supply of methyl bromide will motivate growers to try less frequent applications.
OTHER MEASURES *(please describe)*	Examination of promising but presently unregistered alternative fumigants and herbicides, alone or in combination with non-chemical methods, is planned in all regions (Please see Section 17 for each region for details)	Measures adopted in Michigan will likely be used in the other regions when fungi are the only key pests involved	Measures adopted in Michigan will likely be used in the other regions when fungi are the only key pests involved	Unknown

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

In accordance with the criteria of the critical use exemption, each party is required to describe ways in which it strives to minimize use and emissions of MB. The use of MB in the growing of eggplant 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 eggplant is most often machine injected into soil to specific depths.

As MB 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, MB was typically sold and used in mixtures made up of 98% MB 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 MB. 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 MB. In addition, cultural practices are utilized by eggplant growers.

Reduced MB concentrations in mixtures, cultural practices, and the extensive use of tarpaulins to cover land treated with methyl bromide has resulted in reduced emissions and an application rate that we believe is among the lowest in the world for the uses described in this nomination.

PART E: ECONOMIC ASSESSMENT

Economic data from the 2004 submission for all applicants were not substantially different from those in 2003 (greater or less than a 10% change in costs and revenue). Given these insignificant differences, the economic analyses were not updated for any applicants other than Michigan, which was updated to reflect a change in the requested pounds of MeBr.

The economic assessment is organized by MeBr critical use application. Cost of MeBr and alternatives are given first in table 21.1. This is followed in table 22.1 by a listing of net and gross revenues by applicant. Expected losses when using MeBr alternatives are then further decomposed in tables E1 through E3.

Reader please note that in this study net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be 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.

21. OPERATING COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD:

TABLE 21.1: EGGPLANT – OPERATING COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

ALTERNATIVE	YIELD*	COST IN YEAR 1 (US$/ha)	COST IN YEAR 2 (US$/ha)	COST IN YEAR 3 (US$/ha)
Florida				
Methyl Bromide	100%	$15,322	$15,322	$15,322
1,3-D + Chloropicrin	71%	$14,272	$14,272	$14,272
Metam-Sodium	56%	$13,557	$13,557	$13,557
Georgia				
Methyl Bromide	100%	$32,365	$32,365	$32,365
1,3-D + Chloropicrin	71%	$27,530	$27,530	$27,530
Metam-Sodium	56%	$24,493	$24,493	$24,493
Michigan				
Methyl Bromide	100%	$23,598	$23,598	$23,598
1,3-D + Chloropicrin	94%	$23,185	$23,185	$23,185

** As percentage of typical or 3-year average yield, compared to methyl bromide e.g. 10% more yield, write 110.*

22. GROSS AND NET REVENUE:

TABLE 22.1: EGGPLANT – YEAR 1, 2, AND 3 GROSS AND NET REVENUES

YEAR 1, 2, AND 3		
ALTERNATIVES *(as shown in question 21)*	**GROSS REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*	**NET REVENUE FOR LAST REPORTED YEAR** *(US$/ha)*
Florida		
Methyl Bromide	$21,730	$6,408
1,3-D + Chloropicrin	$15,428	$1,156
Metam-Sodium	$12,169	$(1,388)
Georgia		
Methyl Bromide	$42,857	$10,491
1,3-D + Chloropicrin	$30,428	$2,899
Metam-Sodium	$24,000	$(493)
Michigan		
Methyl Bromide	$34,074	$10,476
1,3-D + Chloropicrin	$29,627	$6,442

NOTE: Year 1 equals year 2 and 3.

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

FLORIDA EGGPLANT - TABLE E.1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

FLORIDA EGGPLANT	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	1,893	1,344	1,060
* PRICE PER UNIT (US$)	$11	$11	$11
= GROSS REVENUE PER HECTARE (US$)	$21,730	$15,428	$12,169
- OPERATING COSTS PER HECTARE (US$)	$15,322	$14,272	$13,557
= NET REVENUE PER HECTARE (US$)	$6,408	$1,156	$(1,388)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$5,252	$7,796
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$35	$52
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	24%	36%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	82%	122%
5. PROFIT MARGIN (%)	29%	7%	-11%

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

GEORGIA EGGPLANT	METHYL BROMIDE	1,3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	6,326	4,491	3,542
* PRICE PER UNIT (US$)	$7	$7	$7
= GROSS REVENUE PER HECTARE (US$)	$42,857	$30,428	$24,000
- OPERATING COSTS PER HECTARE (US$)	$32,365	$27,530	$24,493
= NET REVENUE PER HECTARE (US$)	$10,491	$2,899	$(493)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$7,593	$10,985
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$51	$73
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	18%	26%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	72%	105%
5. PROFIT MARGIN (%)	24%	10%	-2%

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

MICHIGAN EGGPLANT	METHYL BROMIDE	1,3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	3,665	3,445
* PRICE PER UNIT (US$)	$9	$8.60
= GROSS REVENUE PER HECTARE (US$)	$34,074	$29,627
- OPERATING COSTS PER HECTARE (US$)	$23,598	$23,185
= NET REVENUE PER HECTARE (US$)	$10,476	$6,442
1. LOSS PER HECTARE (US$)	$0	$4,034
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$34
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	12%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	39%
5. PROFIT MARGIN (%)	31%	22%

SUMMARY OF ECONOMIC FEASIBILITY

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

Michigan

The US concludes that, at present, no economically feasible alternatives to MeBr exist for use in Michigan eggplant production. Yield losses and missed market windows are the factores that have proven most important in this conclusion, which are discussed individually below.

1. Yield Loss

The US anticipates yield losses of 6% throughout Michigan eggplant production.

2. Missed Market Windows

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

The analysis of this effect is based on the fact that prices farmers receive for their eggplants 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 eggplants are harvested, the supply is at is lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, eggplant growers manage their production systems with the goal of harvesting the largest possible quantity of eggplants when the prices are at their highs. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of eggplant operations.

Specific data representing these market fluctuations are not available for Michigan eggplant. However, because of the similar production system and growing conditions, Michigan pepper price data was used to represent price fluctuations in Michigan eggplant and their impact on growers' gross revenues. Though data availability is limiting, it was assumed that if eggplant growers adjust the timing of their production system, as required when using 1,3-D + chloropicrin, that they will, over the course of the growing season, receive gross revenues reduced by approximately 7.5%. The season average price was reduced by 7.5% in analysis of the alternatives to reflect this. Based on currently available information, the US believes this reduction in gross revenues serves as a reasonable indicator of the typical effect of planting delays resulting when MeBr alternatives are used in Michigan eggplant production.

Florida

No technically (and thus economically) feasible alternatives to MeBr are presently available to the effected eggplant growers. As such, the US concludes that use of MeBr is critical in Florida eggplant production.

Florida's application for MeBr critical use indicated that more than one crop is typically grown per growing season but did not provide specific production and sales data for this crop. As a result of this gap in data, economic assessment of Florida eggplant production was based on a single crop production system. This characterization of growing conditions could result in the critical need for MeBr appearing 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 MeBr is sufficiently strong based solely on yield loss.

Georgia

No technically (and thus economically) feasible alternatives to MeBr are presently available to the effected eggplant growers. As such, the US concludes that use of MeBr is critical in Georgia eggplant production.

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 MeBr is sufficiently strong based solely on yield loss.

PART F. FUTURE PLANS

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

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

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

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

The amount of methyl bromide requested for research purposes is considered critical for the development of effective alternatives. Without methyl bromide for use as a standard treatment, the research studies can never address the comparative performance of alternatives. This would be a serious impediment to the development of alternative strategies. The U.S. government estimates that eggplant research will require 433 kg per year of methyl bromide for 2005 and 2006. This amount of methyl bromide is necessary to conduct research on alternatives and is in addition to the amounts requested in the submitted CUE applications. One example of the research is a field study testing the comparative performance of methyl bromide, host resistance, cultural practices, pest management approaches for control of root-knot nematodes. Another example is a five year field study comparing methyl bromide to 1,3-D combined with biologically based materials including transplant treatments for control of weeds, root-knot nematodes and soil borne fungal pathogens.

24. How Do You Plan to Minimize the Use of Methyl Bromide for the Critical Use in the Future?

25. Additional Comments on the Nomination?

26. Citations

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APPENDIX A. 2007 Methyl Bromide Usage Numerical Index (BUNI).

Methyl Bromide Critical Use Exemption Process	Date:	1/28/2005	Average Hectares in the US:	2,197
2007 Methyl Bromide Usage Numerical Index (BUNI)	Sector:	EGGPLANT	% of Average Hectares Requested:	46%

	2007 Amount of Request			2002 & 2003 Average Use*			Quarantine and Pre-Shipment	Regional Hectares**		Research Amount (kgs)
REGION	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)		2002 & 2003 Average	% of Requested Hectares	
GEORGIA	48,868	325	150	47,713	318	150	0%	539	60%	433
MICHIGAN	3,799	32	120	3,981	33	121	0%	Not Available		
FLORIDA	108,862	647	168	114,623	728	157	0%	647	100%	
TOTAL OR AVERAGE	161,529	1,004	161	166,317	1,079	154	0%	1,186	85%	

2007 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE		
REGION	2007 Request	(-) Double Counting	(-) Growth	(-) Use Rate Adjustment	(-) QPS	HIGH	LOW	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)
GEORGIA	48,868	-	1,155	-	-	29,582	20,517	22,647	151	150
MICHIGAN	3,799	-	-	-	-	3,799	3,799	3,799	32	120
FLORIDA	108,862	-	-	-	-	87,090	64,229	69,601	414	168
Nomination Amount	161,529	161,529	160,374	160,374	160,374	120,471	88,544	96,047	596	161
% Reduction from Initial Request	0%	0%	1%	1%	1%	25%	45%	41%	41%	0%

Adjustments to Requested Amounts	Use Rate (kg/ha)		(%) Karst (Telone)		(%) 100 ft Buffer Zones		(%) Key Pest Distribution		Regulatory Issues (%)		Unsuitable Terrain (%)		Cold Soil Temp (%)		Combined Impacts (%)	
REGION	Low	EPA	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	HIGH	LOW
GEORGIA	150	150	8	8	0	0	58	39	0	0	0	0	0	0	62%	43%
MICHIGAN *	120	120	0	0	0	0	75	75	0	0	0	0	100	100	100%	100%
FLORIDA	168	168	40	40	1	1	58	39	0	0	0	0	0	0	80%	59%

Other Considerations	Dichotomous Variables (Y/N)					Other Issues			Economic Analysis					
REGION	Strip Bed Treatment	Currently Use Alternatives?	Research / Transition Plans	Tarps / Deep Injection Used	Pest-free Cert. Requirement	Change from Prior CUE Request (+/-)	Verified Historic MeBr Use / State	Frequency of Treatment	Loss per Hectare (US$/ha)	Loss per Kilogram of MeBr (US$/kg)	Loss as a % of Gross Revenue	Loss as a % of Net Revenue	Quality/ Time/ Market Window/ Yield Loss (%)	Marginal Strategy
GEORGIA	Yes	Yes	Yes	Tarp	No	0	Yes	1/year	$ 7,593	$ 51	18%	72%	29% yield loss + planting delay	1,3-D + Pic
	Yes	Yes	Yes	Tarp	No	0	Yes	1/year	$ 10,985	$ 73	26%	105%	44% yield loss + planting delay	Metam-Sodium + Pic
MICHIGAN	Yes	Yes	Yes	Tarp	No	0	Yes	1/year	$ 4,034	$ 34	12%	39%	22% Yield Loss + planting delay	1,3-D+Pic
FLORIDA	Yes	Yes	Yes	Tarp	No	-	Yes	1/year	$ 5,252	$ 35	24%	82%	29% yield loss + planting delay	1,3-D + Pic
	Yes	Yes	Yes	Tarp	No	-	Yes	1/year	$ 7,796	$ 52	36%	122%	44% yield loss + planting delay	Metam-Sodium + Pic

* Michigan rates are higher for 2007 based on more current information.

Conversion Units: 1 Pound = 0.453592 Kilograms 1 Acre = 0.404686 Hectare

Most Likely Impact Value High 24% Low 77%

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

1. **Average Hectares in the US** – Average Hectares in the US is the average of 2001 and 2002 total hectares in the US in this crop when available. These figures were obtained from the USDA National Agricultural Statistics Service.
2. **% of Average Hectares Requested** - Percent (%) of Average Hectares Requested is the total area in the sector's request divided by the Average Hectares in the US. Note, however, that the NASS categories do not always correspond one to one with the sector nominations in the U.S. CUE nomination (e.g., roma and cherry tomatoes were included in the applicant's request, but were not included in NASS surveys). Values greater than 100 percent are due to the inclusion of these varieties in the U.S. CUE request that were not included in the USDA NASS: nevertheless, these numbers are often instructive in assessing the requested coverage of applications received from growers.
3. **2007 Amount of Request** – The 2007 amount of request is the actual amount requested by applicants given in total pounds active ingredient of methyl bromide, total acres of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per acre. U.S. units of measure were used to describe the initial request and then were converted to metric units to calculate the amount of the US nomination.
4. **2001 & 2002 Average Use** – The 2001 & 2002 Average Use is the average of the 2001 and 2002 historical usage figures provided by the applicants given in total pounds active ingredient of methyl bromide, total acres of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per acre. Adjustments are made when necessary due in part to unavailable 2002 estimates in which case only the 2001 average use figure is used.
5. **Quarantine and Pre-Shipment** – Quarantine and pre-shipment (QPS) hectares is the percentage (%) of the applicant's request subject to QPS treatments.
6. **Regional Hectares, 2001 & 2002 Average Hectares** – Regional Hectares, 2001 & 2002 Average Hectares is the 2001 and 2002 average estimate of hectares within the defined region. These figures are taken from various sources to ensure an accurate estimate. The sources are from the USDA National Agricultural Statistics Service and from other governmental sources such as the Georgia Acreage estimates.
7. **Regional Hectares, Requested Acreage %** - Regional Hectares, Requested Acreage % is the area in the applicant's request divided by the total area planted in that crop in the region covered by the request as found in the USDA National Agricultural Statistics Service (NASS). Note, however, that the NASS categories do not always correspond one to one with the sector nominations in the U.S. CUE nomination (e.g., roma and cherry tomatoes were included in the applicant's request, but were not included in NASS surveys). Values greater than 100 percent are due to the inclusion of these varieties in the U.S. CUE request that were not included in the USDA NASS: nevertheless, these numbers are often instructive in assessing the requested coverage of applications received from growers.
8. **2007 Nomination Options** – 2007 Nomination Options are the options of the inclusion of various factors used to adjust the initial applicant request into the nomination figure.
9. **Subtractions from Requested Amounts** – Subtractions from Requested Amounts are the elements that were subtracted from the initial request amount.
    10. **Subtractions from Requested Amounts, 2007 Request** – Subtractions from Requested Amounts, 2007 Request is the starting point for all calculations. This is the amount of the applicant request in kilograms.
    11. **Subtractions from Requested Amounts, Double Counting** - Subtractions from Requested Amounts, Double Counting is the estimate measured in kilograms in situations where an applicant has made a request for a CUE with an individual application while their consortium has also made a request for a CUE on their behalf in the consortium application. In these cases the double counting is removed from the consortium application and the individual application takes precedence.
    12. **Subtractions from Requested Amounts, Growth or 2002 CUE Comparison** - Subtractions from Requested Amounts, Growth or 2002 CUE Comparison is the greatest reduction of the estimate measured in kilograms of either the difference in the amount of methyl bromide requested by the applicant that is greater than that historically used or treated at a higher use rate or the difference in the 2007 request from an applicant's 2002 CUE application compared with the 2007 request from the applicant's 2003 CUE application.
    13. **Subtractions from Requested Amounts, QPS** - Subtractions from Requested Amounts, QPS is the estimate measured in kilograms of the request subject to QPS treatments. This subtraction estimate is calculated as the 2007 Request minus Double Counting, minus Growth or 2002 CUE Comparison then

multiplied by the percentage subject to QPS treatments. *Subtraction from Requested Amounts, QPS = (2007 Request – Double Counting – Growth)*(QPS %)*

14. **Subtraction from Requested Amounts, Use Rate Difference** – Subtractions from requested amounts, use rate difference is the estimate measured in kilograms of the lower of the historic use rate or the requested use rate. The subtraction estimate is calculated as the 2007 Request minus Double Counting, minus Growth or 2002 CUE Comparison, minus the QPS amount, if applicable, minus the difference between the requested use rate and the lowest use rate applied to the remaining hectares.

15. **Adjustments to Requested Amounts** – Adjustments to requested amounts were factors that reduced to total amount of methyl bromide requested by factoring in the specific situations were the applicant could use alternatives to methyl bromide. These are calculated as proportions of the total request. We have tried to make the adjustment to the requested amounts in the most appropriate category when the adjustment could fall into more than one category.
    16. **(%) Karst geology** – Percent karst geology is the proportion of the land area in a nomination that is characterized by karst formations. In these areas, the groundwater can easily become contaminated by pesticides or their residues. Regulations are often in place to control the use of pesticide of concern. Dade County, Florida, has a ban on the use of 1,3D due to its karst geology.
    17. **(%) 100 ft Buffer Zones** – Percentage of the acreage of a field where certain alternatives to methyl bromide cannot be used due the requirement that a 100 foot buffer be maintained between the application site and any inhabited structure.
    18. **(%) Key Pest Impacts** - Percent (%) of the requested area with moderate to severe pest problems. Key pests are those that are not adequately controlled by MB alternatives. For example, the key pest in Michigan peppers, *Phytophthora* spp. infests approximately 30% of the vegetable growing area. In southern states the key pest in peppers is nutsedge.
    19. **Regulatory Issues (%)** - Regulatory issues (%) is the percent (%) of the requested area where alternatives cannot be legally used (e.g., township caps) pursuant to state and local limits on their use.
    20. **Unsuitable Terrain (%)** – Unsuitable terrain (%) is the percent (%) of the requested area where alternatives cannot be used due to soil type (e.g., heavy clay soils may not show adequate performance) or terrain configuration, such as hilly terrain. Where the use of alternatives poses application and coverage problems.
    21. **Cold Soil Temperatures** – Cold soil temperatures is the proportion of the requested acreage where soil temperatures remain too low to enable the use of methyl bromide alternatives and still have sufficient time to produce the normal (one or two) number of crops per season or to allow harvest sufficiently early to obtain the high prices prevailing in the local market at the beginning of the season.
    22. **Combined Impacts (%)** - Total combined impacts are the percent (%) of the requested area where alternatives cannot be used due to key pest, regulatory, soil impacts, temperature, etc. In each case the total area impacted is the conjoined area that is impacted by any individual impact. The effects were assumed to be independently distributed unless contrary evidence was available (e.g., affects are known to be mutually exclusive). For example, if 50% of the requested area had moderate to severe key pest pressure and 50% of the requested area had karst geology, then 75% of the area was assumed to require methyl bromide rather than the alternative. This was calculated as follows: 50% affected by key pests and an additional 25% (50% of 50%) affected by karst geology.

23. **Qualifying Area** - Qualifying area (ha) is calculated by multiplying the adjusted hectares by the combined impacts.
24. **Use Rate** - Use rate is the lower of requested use rate for 2007 or the historic average use rate.
25. **CUE Nominated amount** - CUE nominated amount is calculated by multiplying the qualifying area by the use rate.
26. **Percent Reduction** - Percent reduction from initial request is the percentage of the initial request that did not qualify for the CUE nomination.
27. **Sum of CUE Nominations in Sector** - Self-explanatory.
28. **Total US Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.
29. **Dichotomous Variables** – dichotomous variables are those which take one of two values, for example, 0 or 1, yes or no. These variables were used to categorize the uses during the preparation of the nomination.
    30. **Strip Bed Treatment** – Strip bed treatment is ‘yes’ if the applicant uses such treatment, no otherwise.
    31. **Currently Use Alternatives** – Currently use alternatives is ‘yes’ if the applicant uses alternatives for some portion of pesticide use on the crop for which an application to use methyl bromide is made.
    32. **Research/ Transition Plans** – Research/ Transition Plans is ‘yes’ when the applicant has indicated that there is research underway to test alternatives or if applicant has a plan to transition to alternatives.

33. **<u>Tarps/ Deep Injection Used</u>** – Because all pre-plant methyl bromide use in the US is either with tarps or by deep injection, this variable takes on the value 'tarp' when tarps are used and 'deep' when deep injection is used.
34. **<u>Pest-free cert. Required</u>** - This variable is a 'yes' when the product must be certified as 'pest-free' in order to be sold

35. **<u>Other Issues</u>**.- Other issues is a short reminder of other elements of an application that were checked
    36. **<u>Change from Prior CUE Request</u>**- This variable takes a '+' if the current request is larger than the previous request, a '0' if the current request is equal to the previous request, and a '-' if the current request is smaller that the previous request.
    37. **<u>Verified Historic Use/ State</u>**- This item indicates whether the amounts requested by administrative area have been compared to records of historic use in that area.
    38. **<u>Frequency of Treatment</u>** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
39. **<u>Economic Analysis</u>** – provides summary economic information for the applications.
    40. **<u>Loss per Hectare</u>** – This measures the total loss per hectare when a specific alternative is used in place of methyl bromide. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
    41. **<u>Loss per Kilogram of Methyl Bromide</u>** – This measures the total loss per kilogram of methyl bromide when it is replaced with an alternative. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
    42. **<u>Loss as a % of Gross revenue</u>** – This measures the loss as a proportion of gross (total) revenue. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars.
    43. **<u>Loss as a % of Net Operating Revenue</u>** -This measures loss as a proportion of total revenue minus operating costs. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current US dollars. This item is also called net cash returns.
44. **<u>Quality/ Time/ Market Window/Yield Loss (%)</u>** – When this measure is available it measures the sum of losses including quality losses, non-productive time, missed market windows and other yield losses when using the marginal strategy.
45. **<u>Marginal Strategy</u>** -This is the strategy that a particular methyl bromide user would use if not permitted to use methyl bromide.