METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE FOR TURFGRASS SOD 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 Turfgrass Grown in Open Fields

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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.

X Yes ☐ No

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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 Turfgrass Grown in Open Fields

3. CROP AND SUMMARY OF CROP SYSTEM

This is a request for turfgrass sod grown primarily in California, Florida, Georgia, Alabama, and Texas. There are at least 1,143 turfgrass sod producers across the U.S. who farm approximately 132,000 hectares, with a wholesale product value of U.S. $670 million. Methyl bromide is used on approximately 1 percent of the total certified sod area in a single year. Methyl bromide fumigation is primarily needed for areas on which certified turf is produced, particularly when a producer is shifting the species or variety of turf to response to market conditions, disease or pest cycles, or other reason. In such cases, the ability to produce certified sod depends on removing all remnants of off-type grasses. On average, fumigation of the affected soil occurs once every three years. Sod fields are flat fumigated with methyl bromide when first establishing a new sod field; as a pre-plant fumigation when pest pressures become so severe that sod free of pests and off-type perennial grasses cannot be produced; and to eliminate pests of quarantine importance to meet the official requirement of the destination area. Wholesale buyers for most certified sod producers are landscape maintenance contractors, garden centers, building contractors, homeowners, and golf course and athletic field superintendents. Turfgrass sod yields average between 6,400 and 8,700 square meters per hectare per cutting. From planting to harvest, a sod crop takes between 9-12 months to reach maturity.

4. METHYL BROMIDE NOMINATED

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)	NOMINATION AREA (HA)
2006	129,672	432

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

The U.S. nomination is only for those areas where the alternatives are not suitable. In U.S. turf production there are several factors that make the potential alternatives to methyl bromide unsuitable. The efficacy of alternatives is not comparable to methyl bromide in some areas, making these alternatives technically and economically infeasible for use in turfgrass sod production.

Methyl bromide (MB) is the only treatment that consistently provides effective control of off-type perennial grasses, as well as nutsedge and other weeds, nematodes, and insect pests. Preplant fumigation with MB is often required when sod farms are first established on land previously used for row crop farming to reduce perennial weeds and other soil-borne pests. It is used when sod producers shift to new sod varieties or species, in order to produce a uniform turf product. MB is especially useful to remove off-type perennial grass varieties that are phenotypically indistinguishable from the sod crop, but possess different pest resistance traits, rooting characteristics, leaf textures, or different temperature and humidity requirements. Off-type perennial grass varieties infesting the soil from the previous planting cannot be targeted for spot treatment with a herbicides by visually inspecting the crop. Research trials have shown that there is a great variability in efficacy of chemical alternatives (Unruh et al., 2002).

Most "warm season" certified turfgrass sod production utilizes MB when a new sod field is being established or when a change of species and /or variety is desired on an existing sod field. Any turfgrass, particularly "warm-season" species, may become an "off-type" grass when the establishment of a different species is desirable. With some aggressive grasses, a single off-type grass plant can spread rapidly through a field, resulting in a revocation of certification for the affected field. The standards for purity are so strict that even a very small proportion of "off-type" blades of grass will lead to rejection of the sod. Thus, industry certification programs for sod guarantee that the grasses are genetically pure. Uncertified sod can only be sold as "common" or "field" sod used for soil stabilization at 25% of its value as certified sod (a price reduction of 75%). In the United States, sod certification programs operate on a state or regional level, some of which specifically require methyl bromide fumigation as a condition for certification.

Potential alternatives, such as dazomet and metam-sodium, are unreliable and do not provide the degree of consistent pest control needed by the industry to meet market demands. In addition to providing higher rates of efficacy and more consistent results than the other alternatives tested, methyl bromide also allows for quick planting after treatment.

TABLE A.1: EXECUTIVE SUMMARY

TURF		*Turfgrass Producers International*
AMOUNT OF NOMINATION*		
2006	**Kilograms**	129,272
	Application Rate (kg/ha)	300
	Area (ha)	432
AMOUNT OF APPLICANT REQUEST		
2006	**Kilograms**	680,388
	Application Rate (kg/ha)	480
	Area (ha)	1,416
ECONOMICS FOR NEXT BEST ALTERNATIVE		
Next Best Alternative (According to CUE Application)		**Dazomet**
Yield/Quality Loss (%)		25%
Loss per hectare (US$/ha)		$6,634
Loss per kg Methyl Bromide (US$/kg)		$13.82
Loss as % of Gross Revenue (%)		33.81%
Loss as % of Net Revenue (%)		64.23%

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

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE

Registered alternatives, dazomet and metam sodium, are unreliable and do not provide the degree of pest control efficacy needed by the industry. The U.S. consumer market generally demands turfgrass consisting of pure varieties that are uniform, vigorous, densely growing, and free of the pests and pathogens that would reduce its vigor, impede its ability to control erosion. According to the applicant, Turfgrass Producers International, the standards for purity are so strict that even a very small proportion of “off-type” blades of grass will lead to rejection of the sod. Producers of certified turfgrass sod, or vegetative propagules, operate under zero-tolerance standards for pests or off-type perennial grasses. Certified sod produced on methyl bromide fumigated plots receives a higher price than similarly treated sod. The loss in revenue due to loss of certification, yield reduction, and unharvestable fields in the absence of MB can range from approximately 25% to 75% per acre per year (TPI, 2003). Because of the differential susceptibilities of turfgrass varieties to drought, temperature extremes, and pathogens, consumers are very particular about the turfgrass variety that they buy. Off-typing is of particular importance in growing bermudagrass sod where the product is genetically pure. Contamination with off-type perennial grasses can even lead to legal action against the turfgrass producer.

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 (%)
Turfgrass Producers	Not Available	Not Available
National Total:	131,971	<1

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

Approximately 1.1% of turfgrass sod is treated with MB each year, the affected area averaging one treatment every three years. MB is used only in the portion of the turfgrass sod area where pest problems cannot be readily controlled using conventional pesticides. For instance, some broadleaf weeds, such as ragweed, pigweed, and morningglory, may be effectively controlled through continuous mowing previous to seed production (McCarty, undated). Spot treatment with a nonselective herbicide, such as glyphosate, may be used to control competitive grasses that can be easily distinguished from the turfgrass crop. Relatively low pest pressures in most of the turfgrass sod production area make it possible for producers to use alternative pesticides (herbicides, fungicides, nematicides, and insecticides) and cultural practices.

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?

Probably not, since MB is already being used only in crop areas that require MB fumigation to achieve certification, either because the certification program actually requires MB use or because alternatives are not expected to provide the degree of pest control needed by growers to produce high quality, certifiable sod.

8. AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

TABLE 8.1: AMOUNT OF METHYL BROMIDE REQUESTED FOR CRITICAL USE

REGION:	**U.S.**
YEAR OF EXEMPTION REQUEST	**2006**
KILOGRAMS OF METHYL BROMIDE	680,388
USE: FLAT FUMIGATION OR STRIP/BED TREATMENT	Flat Fumigation
FORMULATION *(ratio of methyl bromide/chloropicrin mixture)* TO BE USED FOR THE CUE	Variable
TOTAL AREA TO BE TREATED WITH THE METHYL BROMIDE OR METHYL BROMIDE/CHLOROPICRIN FORMULATION *(m^2 or ha)*	1,416 ha
APPLICATION RATE* *(kg/ha)* FOR THE **FORMULATION**	Not Available
APPLICATION RATE* *(kg/ha)* FOR THE **ACTIVE INGREDIENT**	480
DOSAGE RATE* *(g/m^2)* OF **FORMULATION** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	Not Available
DOSAGE RATE* *(g/m^2)* OF **ACTIVE INGREDIENT** USED TO CALCULATE REQUESTED KILOGRAMS OF METHYL BROMIDE	48

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

9. SUMMARIZE ASSUMPTIONS USED TO CALCULATE METHYL BROMIDE QUANTITY NOMINATED

The amount of methyl bromide nominated by the U.S. was calculated as follows:

- 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 included growth in the request and the growth amount was removed.
- Quarantine and pre-shipment (QPS) hectares is the area in the applicant's request subject to QPS treatments. QPS use was removed in this sector.
- Only the acreage experiencing moderate to heavy key pest pressure was included in the nominated.

TABLE A.2: 2006 SECTOR NOMINATION*

TURFGRASS PRODUCERS INTERNATIONAL		2006
Applicant Request	Requested Hectares (ha)	**1,416**
	Requested Application Rate (kg/ha)	**480**
	Requested Kilograms (kg)	**680,388**
CUE Nominated	Nominated Hectares (ha)	432
	Nominated Application Rate (kg/ha)	300
	Nominated Kilograms (kg)	129,672

2006 Sector Nomination Totals	Overall Reduction (%)	81%
	2006 U.S. CUE Nomination (kg)	129,672
	Research Amount (kg)	1928
	Total U.S. Sector Nominated Kilograms (kg)	**131,600**

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

PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

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

TABLE 10.1: KEY PESTS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY PESTS AND WEED TO GENUS AND, IF KNOWN, TO SPECIES LEVEL	SPECIFIC REASONS WHY METHYL BROMIDE IS NEEDED
Throughout the United States	**Weeds:** mainly off-type perennial grasses, nutsedge (*Cyperus* spp.); crabgrass (*Digitaria spp*.); goosegrass (*Eleusine indica*); common bermudagrass (*Cynodon dactylon*) and turfgrass from the previous crop cycle. **Nematodes:** over 15 genera of parasitic nematodes, such as lance nematodes (*Hoplolaimus spp.*) and sting nematodes (*Belonolaimus longicaudatus*) **Insects:** white grubs (several species of soil-inhabiting scarabaeid beetle larvae)	Producers of certified turfgrass sod operate under zero-tolerance standards for contamination with off-type perennial grasses, other weeds, pests, and diseases. For approximately 1% of the turfgrass sod growing area, this degree of pest control can only be achieved through MB fumigation. The best registered alternatives, dazomet and metam sodium, are unreliable and do not provide the degree of consistent pest control needed by the industry.

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

TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	U.S.
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Turfgrass sod grown from seeds or rhizomes
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)*	None
SOIL TYPES: *(Sand, loam, clay, etc.)*	Varies from clayish-loam to sandy-loam
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	The affected turfgrass sod area is treated with methyl bromide approximately once every 3 years. On average, 1.1% of the total turfgrass sod crop production area in the U.S. is fumigated in any one year.
OTHER RELEVANT FACTORS:	None identified.

TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	Range from temperate to subtropical (USDA Plant Hardiness Zones 5b through 11)											
SOIL TEMP. *(°C)*	Variable, since turfgrass sod is grown throughout the United States.											
RAINFALL *(mm)*												
OUTSIDE TEMP. *(°C)*												
FUMIGATION SCHEDULE[1]						x	x					
PLANTING SCHEDULE						x	x					
KEY MARKET WINDOW	Variable											

[1] On average, 1% of the area is fumigated once every three years.

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

None were identified as being relevant factors.

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

TABLE 12.1: HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1997	1998	1999	2000	2001	2002
AREA TREATED *(hectares)*	1,221	1,232	1,874	1,563	1,029	612
AMOUNT OF MB ACTIVE INGREDIENT USED *(total kilograms)*	595,489	600,619	913,557	762,021	501,568	274,514
FORMULATIONS OF MB *(MB /chloropicrin)*	According to the applicant, the typical formulation used on turfgrass sod is 98:2.					
METHOD BY WHICH MB APPLIED *(e.g. injected at 25cm depth, hot gas)*	Liquid MB is shank injected into soil at a depth of 20-80 cm and covered with polyethylene tarpaulin.					
APPLICATION RATE OF FORMULATIONS IN kg/ha*	498	498	497	498	497	458
APPLICATION RATE FOR THE ACTIVE INGREDIENT IN kg/ha*	488	488	488	488	488	448
ACTUAL DOSAGE RATE OF FORMULATIONS *(g/m^2)**	49.8	49.8	49.7	49.8	49.7	45.8
ACTUAL DOSAGE RATE FOR THE ACTIVE INGREDIENT *(g/m^2)**	48.8	48.8	48.8	48.8	48.8	44.8

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

PART C: TECHNICAL VALIDATION

13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

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		
Dazomet	Dazomet is not a technically feasible alternative because it does not provide consistent control of the target pests listed in Table 10.1. While dazomet may at times control some diseases and weeds, research data suggest that the effectiveness of this chemical is inconsistent (Csinos et al., 1997; Unruh and Brecke, 2001; Unruh et al., 2002). Specifically, dazomet does not consistently provide acceptable control of off-type perennial grasses; other weeds, such as nutsedge; or nematodes. Another disadvantage of the methyl-isothiocyanate generators, such as dazomet, is that they have long residue times in the soil, and this has resulted in phytotoxicity (Banks, 2002). In addition to providing higher rates of efficacy and more consistent results than other alternatives tested, methyl bromide also allows for quick planting after treatment. A methyl bromide treated field can be planted within 48 hours after the plastic cover is removed, while, depending on soil temperature, a minimum period of 14 to 21 days is required for effective fumigation when dazomet is used to treat the soil.	No
1,3-D and 1,3-D + Chloropicrin	1,3-Dichloropropene (1,3-D) is not a technically feasible alternative because although it has good activity against plant-parasitic nematodes, it does not control target weeds, such as off-type perennial grasses. 1,3-D + chloropicrin has added efficacy against many soil-borne fungi resulting from the activity of chloropicrin, but this combination does not control off-type perennial grasses and other key weeds affecting turfgrass production in the limited circumstances where MB is necessary for certification (approximately 1% of the turfgrass production area in any one year). In research conducted with tomatoes comparing methyl bromide with 1,3-D and chloropicrin there was a 3.7 fold increase in nutsedge plants (90 to 340 plants/m^2) between the two treatments (Johnson and Mullinix, 1999), suggesting that similar results might be obtained with turf.	No

NAME OF ALTERNATIVE	**TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE**	**IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?**
Metam-Sodium / Chloropicrin	The metam-sodium + chloropicrin combination is not a feasible methyl bromide alternative because it does not provide consistent control of target weeds, off-type perennial grasses or nematodes (Csinos et al., 1997, Unruh and Brecke, 2001, Unruh et al., 2002). Furthermore, a minimum waiting period of 14 to 21 days is required before planting when metam-sodium is used to treat the soil. Chloropicrin is effective against soil pathogens, but ineffective against most weeds, while metam-sodium does not always provide acceptable levels of nutsedge control (Unruh, et al., 2002).	No

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

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

TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	**DISCUSSION**
Selective Pre- or Post-Emergent Herbicides	Please refer to Item 13 above.

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

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 (Methyl Iodide)	Iodomethane is undergoing registration reviews in the U.S., but not for use on turfgrass.	Not for turfgrass	Unknown
Potassium Azide	This soil fumigant is as effective as MB for controlling key target weeds. However the manufacturer has not requested its registration in the U.S.	No	Unknown

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

Table 16.1: Effectiveness of Alternatives – Nutsedge (*Cyperus* spp.) in Florida[1]

Treatment	Rates	Application Methods	% NusedgeControl[2]			
			Site 1		Site 2	
			6 WAT[3]	44 WAT[3]	3 WAT[3]	15 WAT[3]
Methyl Bromide + Chloropicrin	549 kg/ha + 11 kg/ha	Shank injected	100a	89a	100a	83a
1,3-D + oxadiazon	140 L/ha + 168 kg/ha	Shank injected + surface broadcast	0f	86ab	0c	74ab
Dazomet	392 kg/ha	Surface broadcast followed by rototill followed by soil seal	80abc	57de	78b	58bcd
Dazomet + Chloropicrin	392 +168 kg/ha	Surface broadcast followed by rototill followed by soil seal + shank injected	81ab	63bcd	81b	48cd
Dazomet + 1,3-D	392 kg/ha + 140 L/ha	Surface broadcast followed by rototill followed by soil seal + shank injected	51de	31f	76b	41d
Metam-sodium	748 L/ha	Surface spray followed by rototill followed by soil seal	43e	26f	71b	73ab
Metam-sodium + Chloropicrin	748 L/ha + 168 kg/ha	Surface spray followed by rototill followed by soil seal + shank injected	55cde	38ef	72b	76ab
Metam-sodium + Chloropicrin tarped	748 L/ha + 168 kg/ha	Surface spray followed by rototill + shank injected	64b-e	56de	100a	79ab
Metam-sodium + 1,3-D	748 + 140 L/ha	Surface spray followed by rototill + shank injected	69bcd	50def	87ab	70abc
Untreated Control			0f	0g	0c	0e
LSD (0.05)			25	24	17	23

[1] Modified from Unruh and Brecke (2001) and Unruh et al. (2002)
[2] Numbers followed by the same letter(s) are not significantly different.
[3] Number of weeks after treatment

TABLE 16.2: EFFECTIVENESS OF ALTERNATIVES – WEEDY GRASSES[1] IN FLORIDA [2]

Treatment	Rates	Application Methods	% Weed Control[3]			
			Site 1		Site 2	
			6 WAT[3]	44 WAT[3]	3 WAT[3]	15 WAT[3]
Methyl Bromide + Chloropicrin	549 kg/ha + 11 kg/ha	Shank injected	100a	98a	100a	74ab
1,3-D + oxadiazon	140 L/ha + 168 kg/ha	Shank injected + surface broadcast	0b	53b	13c	71ab
Dazomet	392 kg/ha	Surface broadcast followed by rototill followed by soil seal	98a	93a	83b	44cd
Dazomet + Chloropicrin	392 +168 kg/ha	Surface broadcast followed by rototill followed by soil seal + shank injected	96a	93a	91ab	38d
Dazomet + 1,3-D	392 kg/ha + 140 L/ha	Surface broadcast followed by rototill followed by soil seal + shank injected	100a	95a	90ab	54bcd
Metam-sodium	748 L/ha	Surface spray followed by rototill followed by soil seal	98a	88a	87b	65abc
Metam-sodium + Chloropicrin	748 L/ha + 168 kg/ha	Surface spray followed by rototill followed by soil seal + shank injected	100a	89a	92a	69abc
Metam-sodium + Chloropicrin tarped	748 L/ha + 168 kg/ha	Surface spray followed by rototill + shank injected	100a	94a	100a	70abc
Metam-sodium + 1,3-D	748 + 140 L/ha	Surface spray followed by rototill + shank injected	96a	94a	95ab	59a-d
Untreated Control			0b	0c	0c	0d
LSD (0.05)			35	13	13	27

[1] Grass species include coastal bermudagrass at Site 1 and alexandergrass, broadleaf signalgrass, and common bermudagrass at Site 2.
[2]Modified from Unruh and Brecke (2001) and Unruh et al. (2002)
[3] Numbers followed by the same letter(s) are not significantly different.
[4] Number of weeks after treatment

TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF QUALITY LOSS	BEST ESTIMATE OF QUALITY LOSS[1]
Dazomet, alone or in combination with chloropicrin	Weeds, primarily off-type perennial grasses; secondary target pests include nutsedge, nematodes and insects		Turfgrass sod not fumigated with MB would likely not be certified. The market value of uncertified sod is approximately 25% that of certified sod.
Metam sodium, alone or in combination with chloropicrin			
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**25 %**

[1] Based on quality and yield loss estimates provided by the applicant. Certified sod produced on methyl bromide fumigated plots receives a higher price than similarly treated sod. The loss in revenue due to loss of certification, yield reduction, and unharvestable fields in the absence of MB is approximately 25% per acre per year (TPI, 2003).

17. Are There Any Other Potential Alternatives Under Development which Are Being Considered to Replace Methyl Bromide?

Covering plots treated with metam sodium + chloropicrin with plastic tarpaulin increased the nutsedge control effectiveness of this combination in southern Florida, but not in a western Florida site (Unruh et al., 2002).

18. Are There Technologies Being Used to Produce the Crop which Avoid the Need for Methyl Bromide

No such technologies are available at present for turfgrass sod.

Summary of Technical Feasibility

At present, none of the registered alternatives, dazomet and metam sodium, is as effective as MB as pre-plant soil fumigants for control of off-type perennial grasses and other target weeds on certified turfgrass in approximately 1% of the turfgrass sod area each year. Dazomet and metam-sodium, applied alone or in combination with chloropicrin, may provide fair control of wild and off-type perennial grasses and broad leaf weeds and fair to poor control of nutsedge, but their effectiveness is inconsistent, and sporadic failures have been observed with both chemicals (Unruh and Brecke, 2001). Hence, the turfgrass sod industry cannot rely on their use to satisfy certification program requirements that demand zero tolerance for weeds, diseases, and pests. A recent study in a southern Florida site has shown that using metam-sodium + chloropicrin under polyvinyl tarp can be as effective as MB for controlling target weeds. However, these results were not duplicated in a northern Florida site, where this combination did poorly relative to MB (Unruh et al., 2002). Thus, neither chemical is a suitable MB alternative on a crop that must be declared pest-free to be certified.

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?	MB applied under polyethylene film.	Unidentified	Unidentified	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	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try lower application rates.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try increasing the percentage of chloropicrin.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try less frequent applications.
OTHER MEASURES *(please describe)*	MB applied under polyethylene film.	Unidentified	Unidentified	Only fumigated once every three years

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

As methyl bromide has become more scarce, users in the United States have, where possible, experimented with different mixes of methyl bromide and chloropicrin. Specifically, in the early 1990s, methyl bromide was typically sold and used in methyl bromide mixtures made up of 95% methyl bromide and 5% chloropicrin, with the chloropicrin being included solely to give the chemical a smell enabling those in the area to be alerted if there was a risk. However, with the outset of very significant controls on methyl bromide, users have been experimenting with significant increases in the level of chloropicrin and reductions in the level of methyl bromide. While these new mixtures have generally been effective at controlling target pests, at low to moderate levels of infestation, it must be stressed that the long term efficacy of these mixtures is unknown.

Tarpaulin (high density polyethylene) is also used to minimize use and emissions of methyl bromide. In addition, cultural practices are utilized by turf growers.

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

PART E: ECONOMIC ASSESSMENT

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

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

ALTERNATIVE	YIELD/QUALITY*	COST IN YEAR 1 *(U.S.$/ha)*	COST IN YEAR 2 *(U.S.$/ha)*	COST IN YEAR 3 *(U.S.$/ha)*
Methyl Bromide	100%	$1,235	$1,235	$1,235
Dazomet	75%	$2,964	$2,964	$2,964

** As percentage of typical or 3-year average yield and quality, compared to methyl bromide.*

22. GROSS AND NET REVENUE

TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

YEAR 1		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
Methyl Bromide	$19,619	$10,327
Dazomet	$14,714	$3,693

TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

YEAR 2		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
Methyl Bromide	$19,619	$10,327
Dazomet	$14,714	$3,693

TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

YEAR 3		
ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
Methyl Bromide	$19,619	$10,327
Dazomet	$14,714	$3,693

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

TABLE E.1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

REGION A	METHYL BROMIDE	DAZOMET
YIELD/QUALITY LOSS (%)	0	25%
YIELD PER HECTARE (IN HA/HA)	1	Not Available
* PRICE PER UNIT (U.S.$)	$19,619	Not Available
= GROSS REVENUE PER HECTARE (U.S.$)	$19,619	$14,714
- OPERATING COSTS PER HECTARE (U.S.$)	$9,292	$11,021
= NET REVENUE PER HECTARE (U.S.$)	$10,327	$3,693
LOSS MEASURES		
1. LOSS PER HECTARE (U.S.$)	$0	$6,634
2. LOSS PER KILOGRAM OF METHYL BROMIDE (U.S.$)	$0	$13.82
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	33.81%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	64.24%

SUMMARY OF ECONOMIC FEASIBILITY

The primary economic loss that would be expected in turfgrass is price reduction associated with the inability to market sod as certified, which results in up to a 75% reduction in gross revenue. The small proportion of turf production represented by this nomination is intended for sod growers producing certified sod.

In addition to price reductions from downgraded quality, there are also expected to be some losses from off-type grasses rendering some areas simply unharvestable, either from the presence of off-type grasses, or the required destruction of all grass in a particular area (to prevent the spreading of off-types). The losses are much smaller than the impact of not being able to certify the sod.

The CUE reviewers analyzed crop budgets data for turfgrass to determine the likely economic impact if methyl bromide were not available. The four economic measures in Table E.1 were used to quantify the economic impacts to pre-plant uses for turfgrass. The four economic measures are not independent in such a way that they can be calculated from the same crop budget data. The measures are, however, supplementary to each other in evaluating the CUE applicant's economic viability. These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for methyl bromide users.

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.

As stated earlier in the application, the price of non-certified sod is 75% lower than the price of certified sod. For production areas that would otherwise fumigate with methyl bromide, it is possible that some areas will be able to continue producing certified seed for a limited time, as long as they do not attempt to change variety or species. But, as mentioned earlier in the application, changing variety or species is one primary reason for needed to control off-types of grass.

To reflect a lower bound on impacts, under the assumption that some areas covered by the nomination would delay their shift in grass type, or delay their control of other key pests, the economic analysis used 25% as the yield/price effect. It is important to recognize that in some areas, the loss could be as high as 75%. Using the lower bound, we estimate that a representative grower would suffer $6,634 loss per hectare per year due to inferior product and a lower proportion of harvestable acreage, and an increase of fumigation costs with dazomet (TPI, 2003). The loss as a percentage of gross revenue was estimated at 33.81% and the loss as a percentage of net revenue at 64.24%. These changes are estimated to have a significant economic impact to the sod industry. The results suggest that dazomet is not economically viable as an alternative for methyl bromide.

Part F. Future Plans

23. What Actions Will Be Taken to Rapidly Develop and Deploy Alternatives for This Crop?

Iodomethane, a soil fumigant not registered in the U.S., has shown to be as effective as MB for controlling target weeds in turfgrass sod and is, therefore, a promising alternative. Although iodomethane is currently undergoing registration reviews in the U.S., it is still too early to anticipate the outcome of this process.

Research into MB alternatives began in 1998. Dr. Bryan Unruh, Extension Turfgrass Specialist at the University of Florida has conducted several field trials comparing methyl bromide to several U.S. registered and non-registered fumigants, alone and in combination, for efficacy against target weeds, including off-type perennial grasses. The results indicate that all alternatives tested to date are inferior to MB. This line of research continues.

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 turf research will require 1928 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. This research will compare the comparative performance of methyl bromide to alternative fumigants.

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

The U.S. wants to note that our usage rate is among the lowest in the world in requested sectors and represents efforts of both the government and the user community over many years to reduce use rates and emissions. We will continue to work with the user community in each sector to identify further opportunities to reduce methyl bromide use and emissions.

25. Additional Comments on the Nomination?

MB is currently used by the turfgrass sod industry in approximately 1% of the crop area each year for preplant control of off-type perennial grasses and other target weeds on certified turfgrass sod. Because the market demands high quality turfgrass sod, certification programs maintain a zero tolerance policy for these contaminants, and producers cannot afford to rely on alternatives that provide inconsistent results.

26. Citations

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Csinos, A.S., W.C. Johnson, A.W. Johnson, D.R. Sumner, R.M. McPherson, and R.D. Gitaitis. 1997. *Alternative Fumigants for Methyl Bromide in Tobacco and Pepper Transplant Production*. Crop Prot. 16:585-594.

Johnson, W.C., III and B.G. Mullinix, Jr. 1999. *Cyperus esculentus* interference in *Cucumis sativus*. Weed Sci. 47: 327-331.

McCarty, L.B. undated. Sod Production in Florida. University of Florida Cooperative Extension Service, 29 pp. http://edis.ifas.ufl.edu/LH066

Turfgrass Producers International (TPI). 2003. Methyl Bromide Critical Use Exemption application for Turfgrass Sod, August 5, 2003.

Unruh, J.B. 1998. Methyl bromide is coming soon. Golf Course Management. http://www.gcsaa.org/gcm/1998/nov98/11methylban.html

Unruh, J. B. and B. J. Brecke. 2001. *Seeking Alternatives for Methyl Bromide*. Golf Course Management. 69(3): 65_72.

Unruh, J. B., B. J. Brecke, J. A. Dusky and J. S. Godbehere. 2002. *Fumigant Alternatives for Replacement of Methyl Bromide in Turfgrass*. Weed Technology, 16:379-387, pp 379-387.

Examples of Turfgrass Sod Certification Requirements in the U.S.:

Turfgrass sod certification, Georgia: http://www.pikecreekturf.com/turfcert.php

Turfgrass sod certification, New Jersey: http://www.rce.rutgers.edu/pubs/pdfs/fs738.pdf

Turfgrass sod certification, Tennessee: http://www.state.tn.us/sos/rules/0080/0080_06/0080_06_04.pdf

Turfgrass sod certification, Virginia: http://www.virginiacrop.org/vcia.sodstd.html

APPENDIX A. 2006 Methyl Bromide Usage Numerical Index (BUNI).

Methyl Bromide Critical Use Exemption Process
2006 Methyl Bromide Usage Numerical Index (BUNI)

Date: 2/26/2004
Sector: TURF

Average Hectares in the US:	131,971
% of Average Hectares Requested:	1%

2006 Amount of Request				2001 & 2002 Average Use*			Quarantine and Pre-Shipment	Regional Hectares**		
REGION	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)		2001 & 2002 Average	% of 2001 & 2002 Average	% of Requested Hectares
Turfgrass Producers International	680,388	1,416	480	388,041	821	473	50%	not available	not available	not available
TOTAL OR AVERAGE	680,388	1,416	480	388,041	821	473	50%	not available	not available	not available

2006 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE			
REGION	2006 Request	(-) Double Counting	(-) Growth or 2002 CUE Comparison	(-) Use Rate Difference	(-) QPS	HIGH	LOW	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	% Reduction
Turfgrass Producers International	680,388	-	286,249	118,242	137,949	137,949	96,564	129,672	432	300	81%
Nomination Amount	680,388	680,388	394,139	275,897	137,949	137,949	96,564	129,672	432	300	81%
% Reduction from Initial Request	0%	0%	42%	59%	80%	80%	86%	81%	69%		

Adjustments to Requested Amounts	Use Rate (kg/ha)		(%) Karst Topography		(%) 100 ft Buffer Zones		(%) Key Pest Distribution		Regulatory Issues (%)		Unsuitable Terrain (%)		Cold Soil Temp (%)		Combined Impacts (%)	
REGION	2006	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	HIGH	LOW
Turfgrass Producers International	480	300	0	0	0	0	100	100	0	0	0	0	0	0	100%	70%

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
Turfgrass Producers International	No	Yes	Yes	Tarp	Yes	0	No	1 / 3 years					25%	Dazomet/ Dazomet+Pic/ Metam-Sodium/ Metam+Pic

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

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. **2006 Amount of Request** – The 2006 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. **2006 Nomination Options** – 2006 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, 2006 Request** – Subtractions from Requested Amounts, 2006 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 2006 request from an applicant's 2002 CUE application compared with the 2006 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 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison then

multiplied by the percentage subject to QPS treatments. *Subtraction from Requested Amounts, QPS = (2006 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 2006 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 topography** – Percent karst topography 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 topography.
    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 topography, 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 topography.

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 2006 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. **Tarps/ Deep Injection Used** – 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. **Pest-free cert. Required** - This variable is a ‘yes’ when the product must be certified as ‘pest-free’ in order to be sold

35. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked
    36. **Change from Prior CUE Request**- 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. **Verified Historic Use/ State**- This item indicates whether the amounts requested by administrative area have been compared to records of historic use in that area.
    38. **Frequency of Treatment** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
39. **Economic Analysis** – provides summary economic information for the applications.
    40. **Loss per Hectare** – 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. **Loss per Kilogram of Methyl Bromide** – 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. **Loss as a % of Gross revenue** – 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. **Loss as a % of Net Operating Revenue** -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. **Quality/ Time/ Market Window/Yield Loss (%)** – 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. **Marginal Strategy** -This is the strategy that a particular methyl bromide user would use if not permitted to use methyl bromide.

APPENDIX B. SUMMARY OF NEW APPLICANTS

A number of new groups applied for methyl bromide for 2005 during this application cycle, as shown in the table below. Although in most cases they represent additional amounts for sectors that were already well-characterized sectors, in a few cases they comprised new sectors. Examples of the former include significant additional country (cured, uncooked) ham production; some additional request for tobacco transplant trays, and very minor amounts for pepper and eggplant production in lieu of tomato production in Michigan.

For the latter, there are two large requests: cut flower and foliage production in Florida and California ('Ornamentals') and a group of structures and process foods that we have termed 'Post-Harvest NPMA' which includes processed (generally wheat-based foods), spices and herbs, cocoa, dried milk, cheeses and small amounts of other commodities. There was also a small amount requested for field-grown tobacco.

The details of the case that there are no alternatives which are both technically and economically feasible are presented in the appropriate sector chapters, as are the requested amounts, suitably adjusted to ensure that no double-counting, growth, etc. were included and that the amount was only sufficient to cover situations (key pests, regulatory requirements, etc.) where alternatives could not be used.

The amount requested by new applicants is approximately 2.5% of the 1991 U.S. baseline, or about 1,400,000 pounds of methyl bromide, divided 40% for pre-plant uses and 60% for post-harvest needs.

The methodology for deriving the nominated amount used estimates that would result in the lowest amount of methyl bromide requested from the range produced by the analysis to ensure that adequate amounts of methyl bromide were available for critical needs. We are requesting additional methyl bromide in the amount of about 500,000 Kg, or 2% or the 1991 U.S. baseline, to provide for the additional critical needs in the pre-plant and post-harvest sector.

Applicant Name	2005 U.S. CUE Nomination (lbs)
California Cut Flower Commission	400,000
National Country Ham Association	1,172
Wayco Ham Company	39
California Date Commission	5,319
National Pest Management Association	319,369
Michigan Pepper Growers	20,904
Michigan Eggplant Growers	6,968
Burley & Dark Tobacco Growers USA - Transplant Trays	2,254
Burley & Dark Tobacco Growers USA - Field Grown	28,980
Virginia Tobacco Growers - Transplant Trays	941
Michigan Herbaceous Perennials	4,200

Ozark Country Hams	240
Nahunta Pork Center	248
American Association of Meat Processors	296,800
Total lbs	**1,087,434**
Total kgs	**493,252**