NOMINATING PARTY: The United States of America

FILE NAME: USA CUN11 **POST HARVEST USE FOR COMMODITIES**

BRIEF DESCRIPTIVE TITLE OF NOMINATION:

Methyl Bromide Critical Use Nomination for Post Harvest Use on Commodities (Submitted in 2008 for 2011 Use Season)

QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION:

TABLE 1: QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION

YEAR	NOMINATION AMOUNT
2011	**10,041 kilograms**

(Details on this page are requested under Decision Ex. I/4(7), for posting on the Ozone Secretariat website under Decision Ex. I/4(8).)

In assessing nominations submitted in this format, TEAP and MBTOC will also refer to the original nomination on which the Party's first-year exemption was approved, as well as any supplementary information provided by the Party in relation to that original nomination. As this earlier information is retained by MBTOC, a Party need not re-submit that earlier information.

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

__________________ __________________ __________

Signature Name Date

Title: ____________________________

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

1. PAPER DOCUMENTS: **Title of paper documents and appendices**	**No. of pages**	**Date sent to Ozone Secretariat**
USA CUN11 POST HARVEST: COMMODITIES	12	
2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: ***Title of each electronic file (for naming convention see notes above)**	**No. of kilobytes**	**Date sent to Ozone Secretariat**
USA CUN11 POST HARVEST - Commodities		

* Identical to paper documents

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

COMMODITIES

1. SUMMARY OF NEED FOR METHYL BROMIDE

Commodity fumigation with methyl bromide is used primarily at harvest time, when rapid fumigation is needed to keep up with the large volumes of incoming commodities. Methyl bromide is also used in some situations requiring rapid fumigation prior to shipping.

The USG has applied an aggressive transition rate which is reflected in the nomination amount and detailed in Table 2.

TABLE 2. NOMINATION AMOUNT

2011 Methyl Bromide Usage Newer Numerical Index (BUNNI)

Transition Use Reduction Description Spreadsheet

SECTOR		COMMODITIES				
		California Bean Shippers	California Dried Plum Board	California Walnut Commission	California Date Commission	Sector Total / Average
Quantity Requested for 2010:	Amount (kgs)	1,984	9,399	5,850	2,009	19,242
Quantity Recommended by MBTOC/TEAP for 2010 :	Amount (kgs)	1,984	9,399	5,850	2,009	19,242
Quantity Approved by Parties for 2010:	Amount (kgs)	1,984	9,399	5,850	2,009	19,242
	Volume (1000 m^3)	99	392	130	97	718
	Rate	20	24	45	21	27
Transition from 2010 Baseline Adjusted Value	Percentage (%)	-70%	-60%	-95%	0%	-77%
Quantity Required for 2011 Nomination:	Amount (kgs)	**595**	**6,266**	**1,170**	**2,009**	**10,041**
	Volume (1000 m^3)	**30**	**261**	**26**	**96**	**413**
	Rate	**20**	**24**	**45**	**21**	**24**

2. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE

This sector includes walnut, dried fruit (prunes, raisins, figs), dates, and dried beans, all of which are subject to infestation by several insect pests. Since infestation begins in the field, methyl bromide is used to rapidly fumigate harvested commodities on arrival at processing plants on a daily basis. Most fumigation occurs over several weeks, during the peak production season, as the bulk of the harvest moves from the field into storage and shipping channels. Upon arrival from the field, each load is fumigated with methyl bromide in preparation for shipment to national and international markets. Any one load of commodities is fumigated with methyl bromide only once.

Preliminary research with sulfuryl fluoride indicates that this fumigant is a likely methyl bromide alternative for most commodities. Studies have shown that under vacuum or atmospheric conditions, sulfuryl fluoride is effective against adult, pupal, and larval stages of insects infesting walnuts, although somewhat less effective against the egg stage. These studies, however, have all been conducted using modified, small testing chambers, and results are just beginning to be validated commercially.

Walnuts - Preliminary tests show that sulfuryl fluoride fumigation is comparable to methyl bromide fumigation in its ability to kill diapausing larvae of codling moth, *Cydia pomonella*, inside walnuts. While codling moth eggs are somewhat more tolerant than larvae to sulfuryl fluoride fumigation, they do not occur naturally on walnuts at the time of harvest. The navel orangeworm, *Amyelois transitella*, is primarily a scavenger, but will also infest walnuts after hull split, especially in areas that support high orangeworm populations. Occasionally, larvae emerging from eggs laid directly on walnuts shortly before harvest may penetrate and infest the nutmeat through cracks in the hull. Although insect eggs are relatively more tolerant of fumigants than other life stages, sulfuryl fluoride fumigation is lethal to three-day navel orangeworm eggs when used at the rate of approximately 56.5 mg/L (3.5 lb/1,000 cubic feet) for 24 hours, at normal atmospheric pressure.

Dry Beans - Sulfuryl fluoride is now labeled for use on dry beans, and the California Bean Shippers have plans to test its efficacy in 2009. According to Dow AgroSciences' Fumiguide, sulfuryl fluoride is effective against the cowpea weevil when used at rates of approximately 25.7 mg/L (1.6 lb/1,000 cubic feet), for 24 hours, at normal atmospheric pressure and 80ºF (26.6ºF).

Dates - Methyl bromide is used primarily to control the carob moth and other insects infesting dates. Sulfuryl fluoride is currently labeled for use on dried dates, but most dates grown in the California are harvested fresh. The California Date Commission reports that it is currently testing the efficacy of sulfuryl fluoride on dates, with preliminary results showing less than adequate egg kill, even when the amount used is twice that needed for a comparable methyl bromide fumigation.

Dried Fruit – Sulfuryl fluoride is currently labeled for use on dried fruit for control of several insects. However, no efficacy data specific to these commodities are readily available. The California Dried Plum Board has expressed that, while sulfuryl fluoride appears to have potential as a methyl bromide replacement, various technical and economic issues remain unresolved, and it is, therefore, too early to discuss plans for its adoption.

The potential use of sulfuryl fluoride for commodity fumigation is unrelated to the use of this chemical for structure fumigation. In the fist case, it is the commodities themselves that are fumigated, only once, and just before being shipped to their intended markets. In the second, it is a storage or food processing facility (i.e. a building) that is fumigated periodically, as needed

3. SUMMARY OF RECENT RESEARCH

Sulfuryl fluoride

Walnuts

Quick turn-around time for walnuts at harvest time is the primary justification for methyl bromide use in this sector. Vacuum fumigation with methyl bromide may take 4-6 hours and atmospheric fumigation approximately 24 hours. The methyl bromide use rate for this sector is 3 lb/1,000 cubic feet. Phosphine gas fumigation takes approximately three days and is being used to fumigate walnuts in storage.

Sulfuryl fluoride has been shown to be effective against the adult, pupal, and larval stages of several insect pests of stored products, although somewhat less effective against the egg stage (Fields and White, 2002, Schneider *et al*., 2003). Preliminary tests show that sulfuryl fluoride fumigation is comparable to methyl bromide fumigation in its ability to kill diapausing larvae of codling moth, *Cydia pomonella*, inside walnuts (Leesch, undated). Methyl bromide fumigation of in-shell walnuts has targeted primarily diapausing codling moth larva because this is the most tolerant life stage that may infest the nut at harvest. Data recently submitted to EPA by Dow AgroSciences (Muhareb and Hartsell, undated) indicate that vacuum fumigation with sulfuryl fluoride for four hours is effective against diapausing codling moth larvae at rates of 25 mg/L (1.5 lb/1,000 cubic feet), at 15.6ºC (60.1ºF) and 17-20 mg/L (1.06 - 1.25 lb/1,000 cubic feet), at 25ºC (77.0ºF). While codling moth eggs are somewhat more tolerant than larvae to sulfuryl fluoride fumigation, they do not occur naturally on walnuts at the time of harvest (Wood, 1999; Zettler and Leesch, 2000; Zettler and Gill, undated).

The navel orangeworm, *Amyelois transitella*, is primarily a scavenger, but will also infest walnuts after hull split, especially in areas that support high orangeworm populations. Occasionally, larvae emerging from eggs laid directly on walnuts shortly before harvest may penetrate and infest the nutmeat through cracks in the hull. Although insect eggs are relatively more tolerant of fumigants than other life stages, sulfuryl fluoride fumigation has been shown to be lethal to three-day navel orangeworm eggs when used at the rate of approximately 56.5 mg/L (3.5 lb/1,000 cubic feet) for 24 hours, at normal atmospheric pressure (Zettler and Gill, undated). USDA/ARS researchers plan to continue testing the efficacy and practicality of using sulfuryl fluoride, relative to methyl bromide, to control post-harvest pests of nuts and dried fruit. Sulfuryl fluoride thus appears to be an effective methyl bromide alternative for in-shell walnuts.

Dry Beans

Rapid fumigation at harvest time and during shipping continues to be the primary justification for the use of methyl bromide on dry beans, at the rate of 2.75 lb/1,000 cubic feet. Methyl bromide fumigation targets primarily the Indianmeal moth, *Plodia interpunctella*, cowpea weevil, *Callosobruchus maculatus*, and bean weevil, *Acanthoscelides obtectus*. Sulfuryl fluoride is currently labeled for control of these pests on dry beans, and the California Bean Shippers have plans to test its efficacy in 2009. According to Dow AgroSciences' Fumiguide, sulfuryl fluoride is effective against the cowpea weevil when used at rates of approximately 25.7 mg/L (1.6 lb/1,000 cubic feet), for 24 hours, at normal atmospheric pressure and 80ºF (26.6ºF).

Dates

Methyl bromide is used to rapidly fumigate California dates at harvest time, when up to a million pounds per day are being harvested within a relatively tight timeframe during the fall. Methyl bromide is used on dates at the rate of 1.5 lb/cubic feet. Although several insect may infest dates, the carob moth, *Ectomyelois ceratoniae*, is the more damaging species. The majority of dates grown in the United States are fresh dates and sulfuryl fluoride is currently labeled for use on dried dates only. Still, the California Date Commission, in collaboration with Dow AgroSciences, is currently testing sulfuryl fluoride as a methyl bromide replacement. The California Date Commission reports that it is currently testing the efficacy of sulfuryl fluoride on dates, with preliminary results showing less than adequate egg kill, even when the amount used is twice that needed for a comparable methyl bromide fumigation.

Dried Fruit

A quick turn-around time for dried fruit at harvest time is the primary justification for the current use of methyl bromide, at the rate of 1.5 lb/1,000 cubic feet. Phosphine gas is used for stored dried fruit fumigation. Sulfuryl fluoride is currently labeled for use on dried fruit for control of Indianmeal moth, raisin moth, *Cadra figulilella*, dried fruit beetles, *Carpophilus hemipterus*, navel orangeworm, and other insects that infest these commodities. Efficacy data are not readily available for sulfuryl fluoride fumigation of dried fruit, although the efficacy of this fumigant against some insect pests of stored products has been demonstrated. The California Dried Plum Board has expressed that, while sulfuryl fluoride appears to have potential as a methyl bromide replacement, various technical and economic issues remain unresolved, and it is, therefore, too early to discuss plans for its adoption. According to the Dow AgroSciences Fumiguide, sulfuryl fluoride is effective against the Indianmeal moth when used at a rate of approximately 21 mg/L (1.3 lb/1,000 cubic feet) at normal atmospheric pressure, for 24 hours, at 80ºF (26.6ºF).

Sulfuryl fluoride and propylene oxide

Wample (2006) is investigating the feasibility of using sequential or combined treatments with sulfuryl fluoride and propylene oxide (PPO) as a methyl bromide alternative for control of pest of stored products. It is anticipated that this line of research will determine if combinations of sulfuryl fluoride and PPO will be more efficacious and cost effective than methyl bromide, especially regarding the egg stage of several economically important insects that infest tree nuts and dried fruit.

Propylene Oxide

The U.S. EPA has established tolerances for propylene oxide on prunes, figs, and raisins. However, no comparative efficacy data for commodity fumigation seems to be currently available.

Vacuum

Exposure to vacuum in flexible PVC chambers ("cocoons") is being explored as a means to disinfest cowpeas, dried beans, and other legumes in storage, targeting mainly the cowpea weevil, *Callosobruchus maculatus* (Phillips *et al*., 2006).

Electromagnetic Energy

Ongoing research focusing on the technical feasibility of using radio frequency energy to control insect pests infesting in-shell walnuts is yielding promising results. Wang *et al.* (2006) have demonstrated that radio frequency treatment of walnuts can achieve 100% mortality of fifth-instar navel orangeworm larvae at an average walnut surface temperature of 60°C.

Phosphine

Most commodity operations in the U.S. currently use phosphine, alone and in combination, whenever feasible. Phosphine is suitable for fumigating commodities in storage, where fumigation time is not a factor, but it is generally too slow for treating large commodity volumes that need to be processed rapidly. Phosphine is also corrosive to certain metals, and this characteristic limits its use in some processing plants, especially those outfitted with electronic sorting and processing control equipment

4. ECONOMIC INFEASIBILITY OF ALTERNATIVES

TABLE 3. ECONOMIC SUMMARY FOR EACH ALTERNATIVE

METHYL BROMIDE ALTERNATIVE	ECONOMIC SUMMARY
PHOSPHINE	Economic losses from additional production downtimes due to longer fumigation time and from capital expenditures required to adopt an alternative. Economic losses due to downtime with phosphine are persistent.
SULFURYL FLUORIDE	SF is a viable alternative to MeBr; costs per lb are comparable but application rates may be higher. Walnuts have inelastic demand; cost increase can be passed to consumers. Higher application rates will not change.

A separate economic analysis of alternatives was conducted for each commodities sub-sector; in each case, phosphine was not found to be economically feasible for any of the commodities. For phosphine, production downtime was estimated to be 84 days per year on average; total capital expenditures for electrical modifications due to corrosive nature of phosphine was assumed to be \$215 per 1000 m^3. The potential economic losses associated with the use of phosphine mainly originate from the cost of production delay. The estimated economic losses are shown in Tables E.1 through E.3. The estimated economic losses as a percentage of net revenue are over 100% for all CUE applicants in the commodity sector; that is, all applicants experience negative net revenues with use of phosphine.

Sulfuryl fluoride was found to be technically and economically feasible for walnuts, dried fruit, and dried beans.

Walnuts

The United States walnut industry is concentrated in the state of California where production averaged 332,000 short tons of walnuts per year from 2003-2007. The largest processor is the Diamond Foods in Stockton, California that processes walnut harvest from 1,700 growers in California – accounting for approximately 50% of the post-harvest market.[1] The United States is one of the world's largest exporters of both shelled and in-shell walnuts.[2] Both production and sales peak in the fall in anticipation of the holiday season in December. Approximately 25 percent of walnuts are sold in the shell.[3] Those that are packed and shipped to European market within a couple of days of the fumigation treatment qualify for quarantine exemptions for Methyl Bromide use. Those that are sold domestically or not immediately shipped may apply for a CUE. The remaining 75 percent of walnuts are processed further to create a variety of packaged shelled products. These walnuts must be fumigated before they are put in long-term storage or continue in the processing chain due to the key pests. Phosphine can be used for the 75 percent of walnuts that are allocated for packaged shelled products because turnaround time is not crucial.

[1] http://www.diamondfoods.com/growers/
[2] http://www.fas.usda.gov/htp/horticulture/Tree%20Nuts/Walnuts.pdf
[3]

The economic analysis is conducted on a per 1,000 cubic meter basis. Phosphine for the in-shell product results in down-time that leads to decreased prices after market window. Sulfuryl fluoride results in slightly higher costs due to higher application rates but there is no additional downtime. Prices per lb for methyl bromide and sulfuryl fluoride are comparable. Use of sulfuryl fluoride results in a 1.65% decrease in net revenue assuming that no costs are passed on to the consumer. Given that walnuts have a price elasticity of demand of -0.28 (Russo et al., 2008), the additional cost of SF fumigant gas could be passed on to the consumer.

TABLE 4: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR WALNUT

Walnuts	Units	MB	Phosphine	SF
Total Commodity Treated	kg	301,548,208	301,548,208	301,548,208
1,000 cubic meters treated	kcm	941.25	941.25	941.25
Avg Mkt Price	$/kg	$ 1.89	$ 1.55 [1]	$ 1.89
Gross Revenue	$/kcm	$ 6,635.34	$ 497,440.98	$ 606,635.34
Total Operating Costs	$/kcm	$ 531,233.52	$ 529,714.86	$ 532,479.97
Total Fumigation Cost (1x)	$/kcm	$ 6,934.61	$ 5,200.96 [2]	$ 7,220.40
Kg Fumigant per kcm	kg/kcm	48.06	na	56.06
Fumigant Cost (i.e., gas)	$/kcm	$ 1,697.93	na	$ 1,980.86
Other fumigation costs (i.e., tarps, etc.)	$/kcm	$ 5,236.68	$ 5,200.96	$ 5,239.54
Other Operating Costs	$/kcm	$ 524,298.90	$ 524,513.89	$ 525,259.57
Net Revenue	$/kcm	$ 75,401.83	$ (32,273.88)	$ 74,155.36
Time Lost	days	0	84	0
Total Loss (MeBr to alt)	$/kcm	$ -	$ 107,675.71	$ 1,246.46
Loss per Lb MeBr Requested	$/kg MeBr	$ -	$ 2,240.66	$ 25.94
Loss as % of GR with MeBr		na	17.75%	0.21%
Loss as % of NR with MeBr		na	142.80%	1.65%

1 Time lost with phosphine is assumed to result in a lower average market price for walnuts because less would be treated during peak prices, and increased supply at other times would depress off-peak prices.

2 Total fumigation costs; breakdown for gas and operating costs not available.

Dried Fruit

The dried fruit industry has already replaced a large portion of methyl bromide with phosphine in processing dried fruits.

As in previous analyses, EPA reviewers estimated that having to rely on phosphine alone would require an additional 84 days treatment time. In addition to the production loss, there are increased costs from using phosphine. Additional expenditures are required to adopt phosphine for accelerated replacement of plant and electronic equipment due to the corrosive nature of phosphine. The net effect of production losses and cost increases is shown in Table 3.

TABLE 5: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR DRIED FRUIT

Dried Fruit	**Units**	**MB**	**Phosphine**	**SF**
Kgs of commodity Treated	**kg**	405,882,980	292,235,746 [1]	405,882,980
1,000 cubic meters treated	**kcm**	1,266.92	912.18	1,266.92
Avg Mkt Price	**$/kg**	$ 1.17	$ 0.96	$ 1.17
Gross Revenue	**$/kcm**	$ 374,457.83	$ 307,055.42	$ 374,457.83
Total Operating Costs	**$/kcm**	na	na	na
Total Fumigation Costs	**$/kcm**	$ 446.75	$ 544.28	$ 542.87
Quantity of Fumigant per unit	**Kgs/kcm**	24.03	na	40.05
Fumigant Cost (i.e., gas)	**$/kcm**	$ 144.17	$ 144.17	$ 240.28
Other fumigation costs (i.e., tarps, etc.)	**$/kcm**	$ 302.59	$ 302.59	$ 302.59
Other Operating Costs	**$/kcm**	na	$ 97.52	na
Time Lost	**days**	0	84	0
Total Annual Loss (MeBr to alt)	**$/kcm**	$ -	$ 67,499.93	$ 96.11
Annual Loss per Lb MeBr Requested	**$/kg MB requested**	$ -	$ 2,809.26	$ 4.00
Loss as % of GR with MeBr		na	18.03%	0.03%

1 Time lost with phosphine is assumed to result in a lower dried fruit produced overall resulting in lower gross revenues.

Dried Beans

In previous analyses, no economic analysis was conducted for dried beans because the industry is subject to a market window and there were no fast alternatives. Now that the MRLs for sulfuryl fluoride have been resolved, this chemical is a viable alternative to methyl bromide.

TABLE 6: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR DRIED BEANS

Dried Beans	Units	MB	SF
Kgs of Commodity (1 sack = 45 kgs)	kg	45	45
Gross Revenue (per sack)	$/sack	$ 30.00	$ 30.00
Total Operating Cost (per sack)	$/sack	$ 26.00	$ 26.34
Total Fumigation Cost	$/sack	$ 5.00	$ 5.34
Quantity of Fumigant per unit	Kgs/kcm	44.05	56.06
Fumigant gas (i.e., gas)	$/sack	$ -	$ -
Other fumigation costs (i.e., tarps, etc.)	$/sack	$ -	$ -
Other Operating Costs	$/sack	$ 21.00	$ 21.00
Net Revenue	$/sack	$ 4.00	$ 3.66
Time Lost	days	0	0
Total Loss (MeBr to alt)	$/sack	$ -	$ 0.34
Loss per Kg MeBr Requested	$/kg MB requested	$ -	$ 0.01
Loss as % of GR with MeBr		na	1.13%
Loss as % of NR with MeBr		na	8.50%

Dates

An economic analysis was not done for dates because sulfuryl fluoride is labeled specifically for "dates, dried" and efficacy tests have not been conducted for this alternative.

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