MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

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MAY 2017

EVALUATION OF 2017 CRITICAL USE NOMINATIONS FOR METHYL BROMIDE AND RELATED MATTERS

INTERIM REPORT

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MAY 2017 REPORT OF THE TECHNOLOGY AND ECONOMIC ASSESSMENT PANEL

EVALUATION OF 2017 CRITICAL USE NOMINATIONS FOR METHYL BROMIDE AND RELATED MATTERS

INTERIM REPORT

MBTOC INTERIM CUN REPORT – MAY 2017

Common Acronyms

1,3-D	1,3-dichloropropene
A5	Article 5 Party
ASD	Anaerobic soil disinfestation
CUE	Critical Use Exemption
CUN	Critical Use Nomination
DMDS	Dimethyl disulphide
DOI	Disclosure of Interest
EU	European Union
ExMOP	Extraordinary Meeting of the Parties
EPA	Environmental Protection Agency
EPPO	European Plant Protection Organisation
IM	Iodomethane
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ISPM	International Standard Phytosanitary Measure
LPBF	Low Permeability Barrier Film (including VIF films)
MB	Methyl Bromide
MBTOC	Methyl Bromide Technical Options Committee
MITC	Methyl isothiocyanate
MOP	Meeting of the Parties
MS	Metham (metam) sodium
Non-A5	Non Article 5 Party
OEWG	Open Ended Working Group
Pic	Chloropicrin
QPS	Quarantine and Pre-shipment
SF	Sulfuryl fluoride
TEAP	Technology and Economics Assessment Panel
TIF	Totally Impermeable Film
VIF	Virtually Impermeable Film
VOC	Volatile Organic Compounds

2017 Evaluation of Critical Use Nominations for Methyl Bromide and Related Matters – Interim Report

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2017 Evaluation of Critical Use Nominations for Methyl Bromide and Related Matters

1.0 Executive Summary

MBTOC received eight CUNs from five Parties for use of 297.918 tonnes of methyl bromide (MB) in 2018 (seven nominations) and 2019 (one nomination). This was a 12% reduction of the request for critical use nominations in 2016. The majority of the request (83%) was for preplant soil use against soilborne fungal pathogens, nematodes and weeds and the remaining 17% for structure and commodity uses against insect pests.

Interim recommendations were made on 7 out of 8 nominations for 232.77 tonnes and one nomination was unable to assess. One nomination from China was recommended in full as MBTOC noted the parties' progress towards phase out of MB and its intention to cease applying for CUNs next year for all uses in 2019. Six nominations received an interim recommendation, which was reduced to account for alternatives that are considered suitable or emission reduction practices or reduction of dosage rates required of methyl bromide.

The accounting framework information received from parties reporting under Article 7 shows that a total of 91 tonnes of stocks have been reported to be available in both non A5 and A5 at the end of 2016.

MBTOC is concerned that there is a large discrepancy possibly up to 15,000 t in the emissions determined from the natural and reported uses for controlled uses and the global emissions of methyl bromide (See TEAP Progress Report, 2017). If uses are unreported then more uses exist than those identified by parties and this could impact the number of critical uses nominated in the future.

1.1 Scope of the Report

The 2017 interim report provides evaluations by MBTOC of Critical Use Nominations (CUNs) for methyl bromide (MB) submitted for 2018 and 2019 by five Parties: two non-A5 (Australia and Canada) and three A5 (Argentina, China and South Africa). As per provisions set out in Decision IX/6 (Annex I, MOP16), CUNs were required to be submitted by the Parties to the Ozone Secretariat in accordance with the timetable shown in paragraph 1 of Annex I, Decision XVI/4 .

This report also provides; 1) interim recommendations for the CUNs for which the Parties provided information as per the timelines set at the 26th Meeting of the Parties, 2) information from Parties on stocks (Decision Ex.1/4 (9f)), 3) partial information on actual MB consumption for critical uses (in accordance with Decision XVII/9), and 4) indication of adoption rates of alternatives, as evidenced by trend lines on reduction of MB for CUNs (in accordance with Decisions XIX/9, XX/5). It is noted that trend lines on adoption may not necessarily indicate true adoption rates for alternatives, as the use of stocks of MB may have been available for use, although for non A5 Parties stocks are now small (see Table 1-3). MBTOC notes that stock volumes have significantly decreased in recent years.

Standard presumptions used in this round in 2017 were the same as those used in the 2016 evaluations of the CUNs. These are subjected to continual review. However, it is required that any changes proposed by MBTOC be approved by the Parties in the MOP preceding the year of assessment based on a draft Decision presented to the MOP in accordance with paragraph 2 in Annex 1 to the report of MOP16.

1.2 Critical Use Nominations for Methyl Bromide

1.2.1 Mandate

Under Article 2H of the Montreal Protocol, Parties not operating under Article 5(1) (non-A5 Parties) were required to phase-out all production and consumption (defined as production plus imports minus exports) of MB after 1stJanuary 2005. The same requirements applied to Parties operating under

Article 5(1) (A5 Parties) after 1st January 2015. However, the Parties agreed to a provision enabling exemptions for those uses of MB that qualify as critical. Under Decision IX/6 of the Protocol Parties established criteria, which all critical uses need to meet in order to qualify for an exemption (see Annex I of this report). TEAP and its MBTOC have provided guidance to the Parties on recommendations regarding critical use exemptions in accordance with Decisions IX/6, Annex I of Decision XVI/2 and a number of subsequent decisions (XVI/2; XVII/9, XVIII/13, XIX/9, XX/5, XXI/11, XXII/6, XXIII/4,XXIV/5 XXV/4, XXVI/2, XXVII/3 and XXVIII/7).

MBTOC considers that any chemical or product registered for a particular use has been through the rigours of the national local regulatory authorities and accepts that these fall within guidelines for health effects and environmental acceptability. MBTOC particularly takes note of those products, which are generally listed in any CUN application.

Under Decision Ex I/4 it is stated that amounts of MB applied for in subsequent CUNs should '*avoid any increase in methyl bromide consumption except for unforeseen circumstances*'

1.2.2 Fulfilment of Decision IX/6

Decisions XVI/2 and XXI/11 directed MBTOC to indicate whether all CUNs fully met the requirements of Decision IX/6. When the requirements of Decision IX/6 are met, MBTOC can recommend critical uses of MB. When the requirements of Decision IX/6 are not met, MBTOC does not recommend critical uses of MB. Where some of the conditions are not fully met, MBTOC can recommend a decreased amount depending on its technical and economic evaluation, or determine the CUN as "unable to assess" and request further information from the Party. When the information is submitted, MBTOC is required to re-assess the nomination, following the procedures defined in Annex 1 of the 16th Meeting of the Parties.

MBTOC recommended less MB than requested in a CUN when technically and economically feasible alternatives were considered to be available, in the sense of Decision IX/6, or, when the Party failed to show that there was no technically and economically feasible alternative for part of the nomination. MBTOC may have accepted that some allocation was appropriate to permit timely phase out of MB. In this round, MBTOC did not recommend one nomination as important information essential to the assessment had not been supplied and the nomination did not meet the requirements of Decision IX/6. In this round of CUNs, as in previous rounds, MBTOC considered all information provided by the Parties, including answers to questions from MBTOC and all additional information submitted by the Parties up to the date of the evaluation.

Now that technically and economically feasible alternatives have been identified for virtually all applications of MB, regulations on the use of these alternatives often determine their availability to the end users. In view of the large numbers of sectors which have moved effectively to alternatives, it was considered particularly important in this round for the Parties, and particularly for A5 Parties submitting CUNs, to clearly identify why MB is considered critical for the specific circumstances of the nomination. Comparative information on the economic feasibility/infeasibility of the use of alternatives with respect to MB is also becoming more critical to the outcomes of present and future CUNs. In particular, MBTOC needs annual updates of the economics information evaluating the costs of alternatives.

1.2.3 Accounting Frameworks for Critical Use

Under the Dec Ex 1/4 9(f) Parties previously applying for Critical Uses are required to continue to submit Accounting Frameworks. MBTOC suggests that Parties may wish to consider a revision to submission of frameworks so that parties are more aware of their need to supply information on stocks. MBTOC suggest that they need to be provided from those Parties, which either have been granted critical uses for the year of reporting or where stocks of methyl bromide exist for countries that have previously used methyl bromide. These stocks need to be reported as of the end of the year prior to the year of reporting.

For this 2017 round, all parties submitted Accounting Frameworks. MBTOC is concerned that stocks may exist in A5 parties applying for CUNs and also in parties not applying for CUNs that are not

being reported. The Frameworks showed that there were approximately 91.0 t of stocks, however their source (i.e. prior to 2015 or post 2015) was not provided for the A5 parties and this is important as it has implications for future use of methyl bromide for controlled uses.

A number of decisions (Ex.I/4 (9f); XVI/2(4); XVII/9(5) and subsequent 'Critical Use' Decisions set out provisions which request Parties to submit in Accounting Frameworks by 1st February each year information on how criteria in IX/6(1) are met when licensing permitting or authorizing CUEs. Decision XVII/9 of the 17th MOP sets the timeline for reporting and also specifically requests TEAP and its MBTOC to "*report for 2005 and annually thereafter, for each agreed critical use category, the amount of MB nominated by a Party, the amount of the agreed critical use and either:*

(a) The amount licensed, permitted or authorised; or
(b) The amount used

Since the start of the CUN reviews in 2003, MBTOC has provided tables of the historic amounts of MB nominated and agreed for each critical use (Annexes III and IV). Additionally Parties provide accounting frameworks on amounts used for critical uses and stocks as required under Dec Ex.1/4 (9f) (Table1-3). The same requirements apply to A5 Parties after 2015.

For 2016, the Meeting of the Parties (MOP) authorised Australia to use 29.760 t of MB (Table 1.3). The Party reported that 29.75 t were used for the critical uses in 2016 and 0.01 authorised but not used. For Canada in 2016, the MOP authorised 5.261 t for strawberry runners and the Party reported that new imports of 4.349 t and stocks from the previous year were used for the critical uses in 2016. For the USA, the MOP authorized 141 t of which 131 t was used for CUEs in 2016. For A5 critical uses, the Parties authorized 38.84 t for strawberry fruit and 64.10 t for tomatoes in Argentina; 74.617 t and 18.360 t for ginger open fields and in protected cropping in China respectively and 59.1 t for Mills (55 t) and structures (4.1 t) in South Africa.

This is the fourth year that A5 Parties have submitted CUNs. Under Decision Ex1/4 (9f) those A5 Parties which are granted critical uses need to provide accounting frameworks annually, if CUNs are again submitted. Additionally Parties were required to submit National Management Plans as required under Decision Ex. I/4(3). No detailed plans were received and China was the only Party to submit a summary of their intended phase out dates.

1.2.4 Trends in Methyl Bromide Use for CUEs since 2005

Decision XVII/9 requires TEAP to show trends in the phase out of the critical uses of MB (Fig 1-1 to Fig 1-4, Annexes III and IV). Since 2005, there has been a progressive downward trend in the officially reported amounts of MB requested for CUNs by all Parties for both soil and post- harvest uses, although this has occurred at different rates. Fig 1-1 and Tables 1.4a-1.4c shows reduction trends in amounts approved/nominated by Parties for 'Critical Use' from 2005 to 2017 for all uses. Fig 1-2 shows the reduction trend for the remaining soil uses in both non-A5 Parties (strawberry runners, Canada and Australia) and Figs 1-3 and 1-4 the current pre-plant soil and commodity uses in A5 Parties (Argentina, China and Republic of South Africa) since 2015. The complete trends in phase out of MB by country, as indicated by change in CUE, are shown in Annexes III and IV.

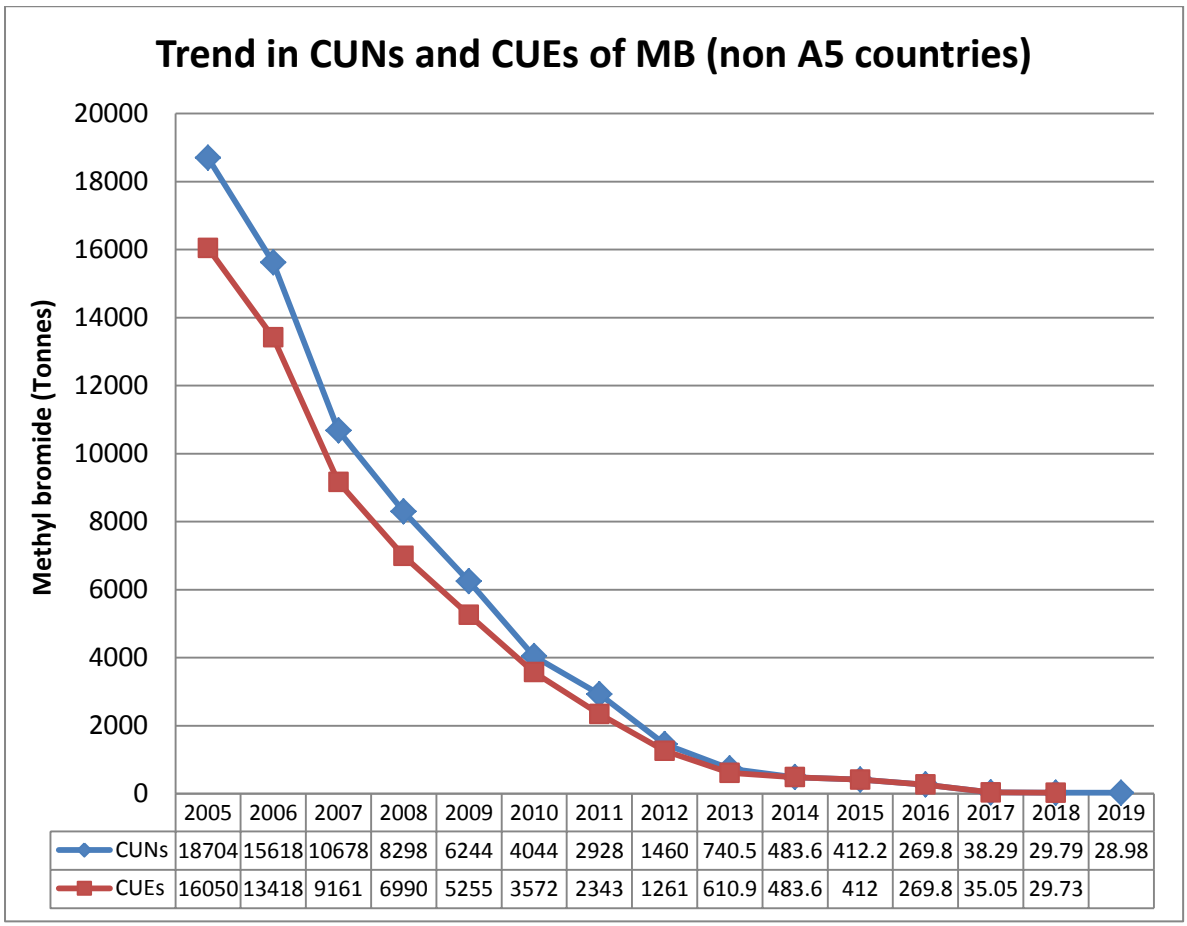
The nominated amounts and the apparent rate of reduction in MB or adoption of alternatives achieved by Parties are shown in Table 1-5, as well as Figures 1-1 to 1-4(a) to 1-4(c). It is noted that for those non-A5 countries that have pre-2005 stocks of MB that are being drawn down, the reductions in CUEs from year to year cannot be taken directly as evidence of adoption of alternatives since pre-2005/2015 stocks may have been used (or may still be used) in the same sectors.

1.2.5 Disclosure of Interest

As in past reports, MBTOC members were requested to update their disclosure of interest forms relating specifically to their level of national, regional or enterprise involvement for the 2017 CUN process. The Disclosure of Interest declarations for 2017, updated in February 2017 can be found on the Ozone Secretariat website at: http://ozone.unep.org/en/assessment-panels/383/disclosure-

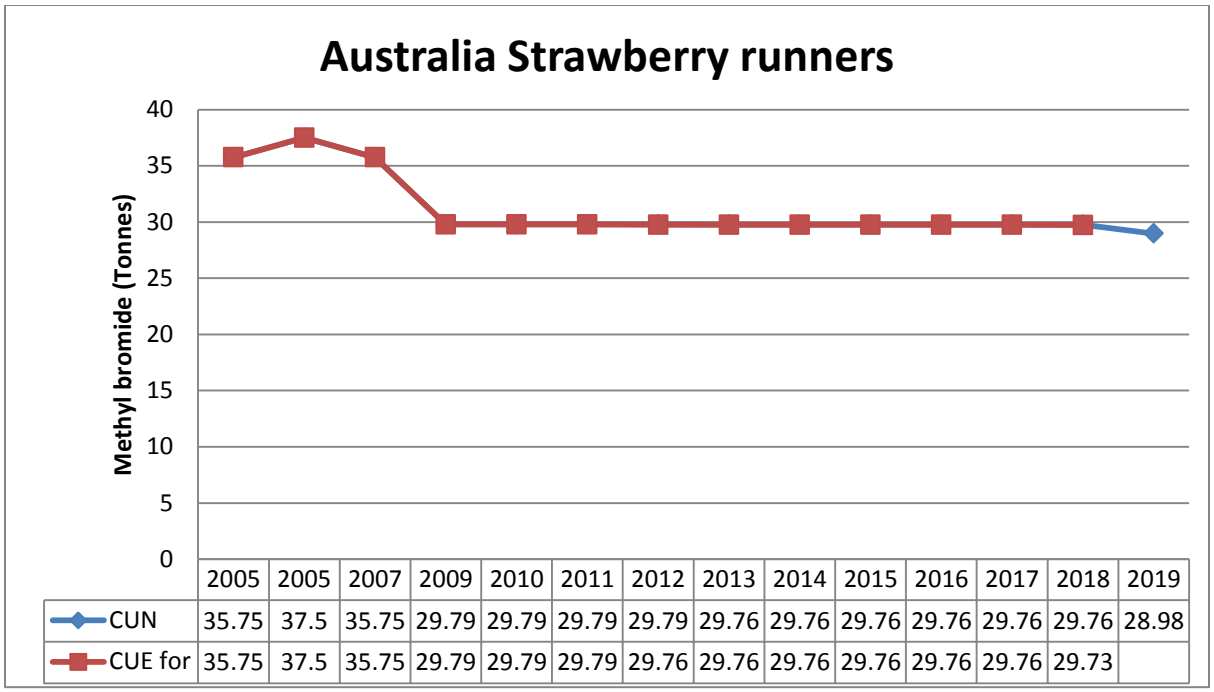
interest?field_subsidiary_body=391 and a list of members at the end of this report. As in previous rounds, some members recused from or abstained to participate in a particular CUN assessment or only provided technical advice on request, for those nominations where a potential conflict of interest was declared. Details of recusals can be found in section 1.3.2.

Figure 1.1. Amounts of MB nominated and exempted for CUE uses in nominated preplant soil and commodities sectors from 2005 to 2018 by non A5 countries

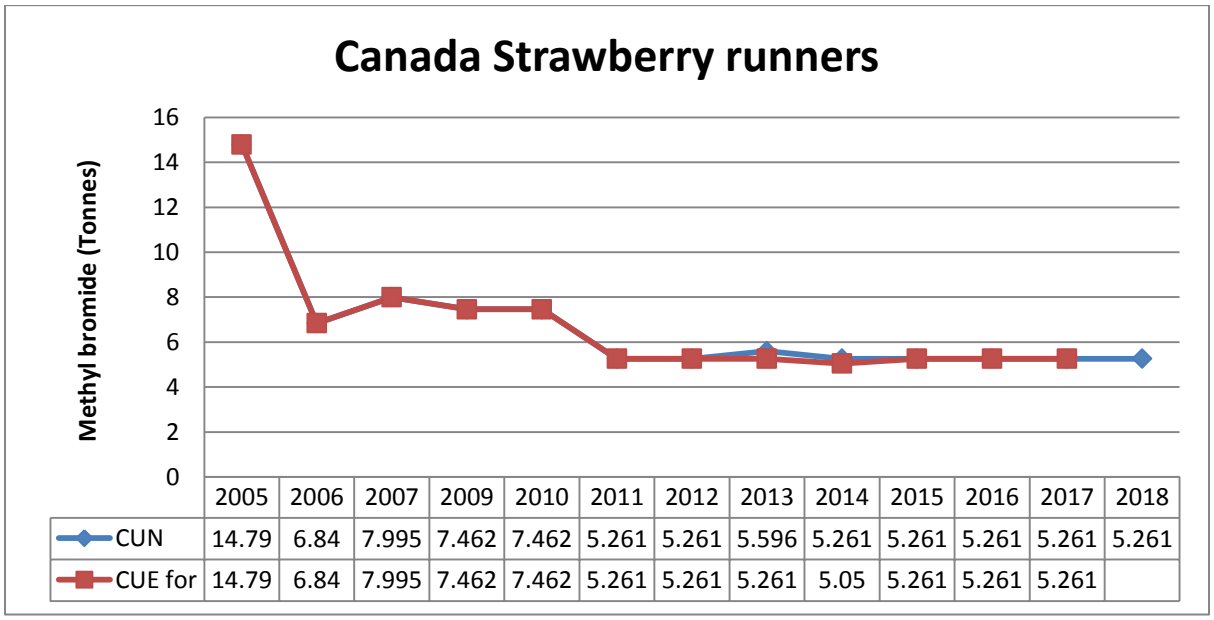


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
CUNs	18704	15618	10678	8298	6244	4044	2928	1460	740.5	483.6	412.2	269.8	38.29	29.79	28.98
CUEs	16050	13418	9161	6990	5255	3572	2343	1261	610.9	483.6	412	269.8	35.05	29.73	

Figure 1.2. Amounts of MB nominated and exempted for CUE uses in nominated preplant soil sectors from 2005 to 2019 by non A5 countries: Australia and Canada. Blue lines indicate the trend in MB nominated in the CUN and the red lines the amount of MB approved as a CUE by the Parties



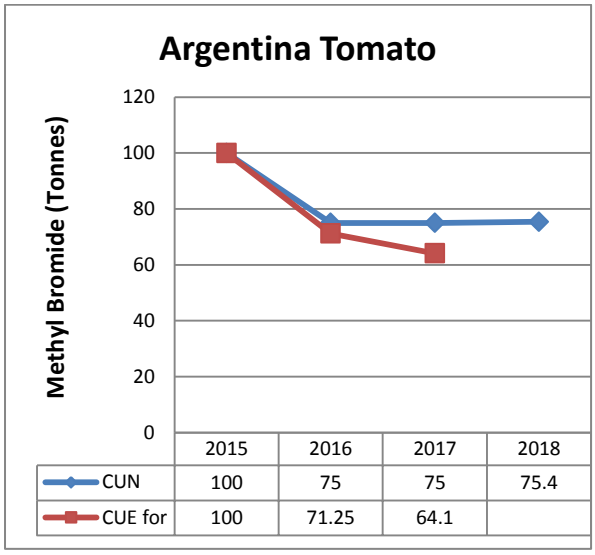
	2005	2005	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
CUN	35.75	37.5	35.75	29.79	29.79	29.79	29.79	29.76	29.76	29.76	29.76	29.76	29.76	28.98
CUE for	35.75	37.5	35.75	29.79	29.79	29.79	29.76	29.76	29.76	29.76	29.76	29.76	29.73	

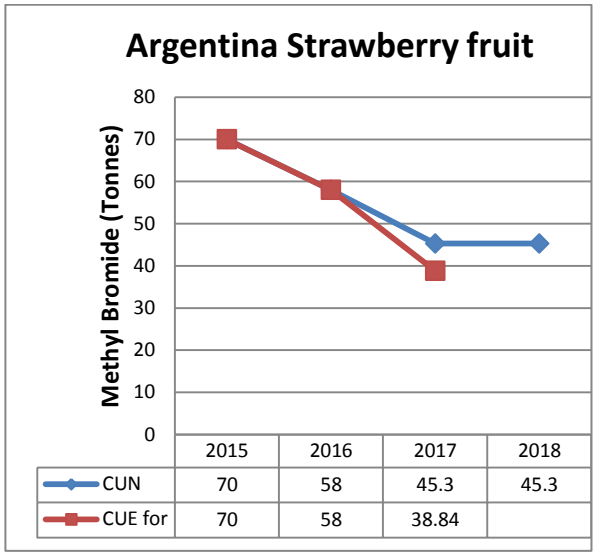


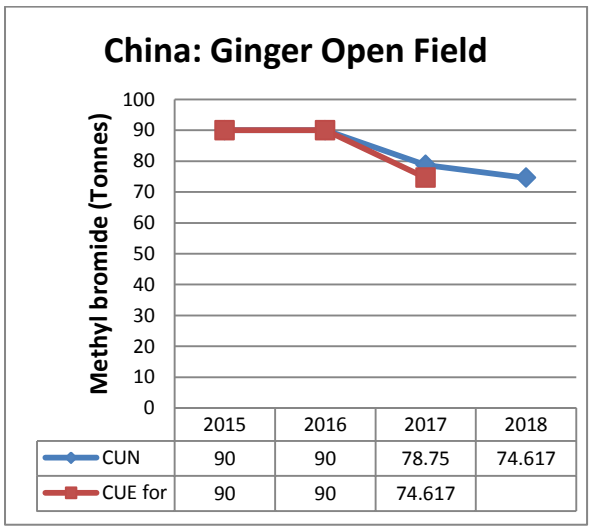
	2005	2006	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CUN	14.79	6.84	7.995	7.462	7.462	5.261	5.261	5.596	5.261	5.261	5.261	5.261	5.261
CUE for	14.79	6.84	7.995	7.462	7.462	5.261	5.261	5.261	5.05	5.261	5.261	5.261	

* Prince Edward Island

Figure 1.3. Amounts of MB nominated and exempted for CUE uses in nominated preplant soil sectors from 2015 to 2018 by A5 countries: Argentina, China and Mexico. Blue lines indicate the trend in MB amounts nominated in the CUN and the red lines the amount of MB approved as a CUE by the Parties







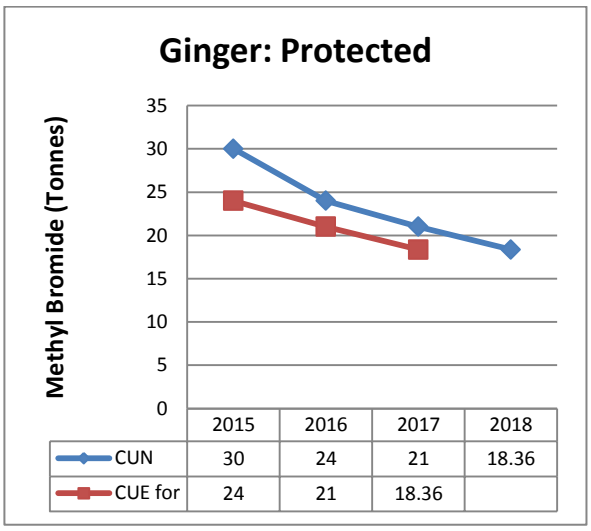
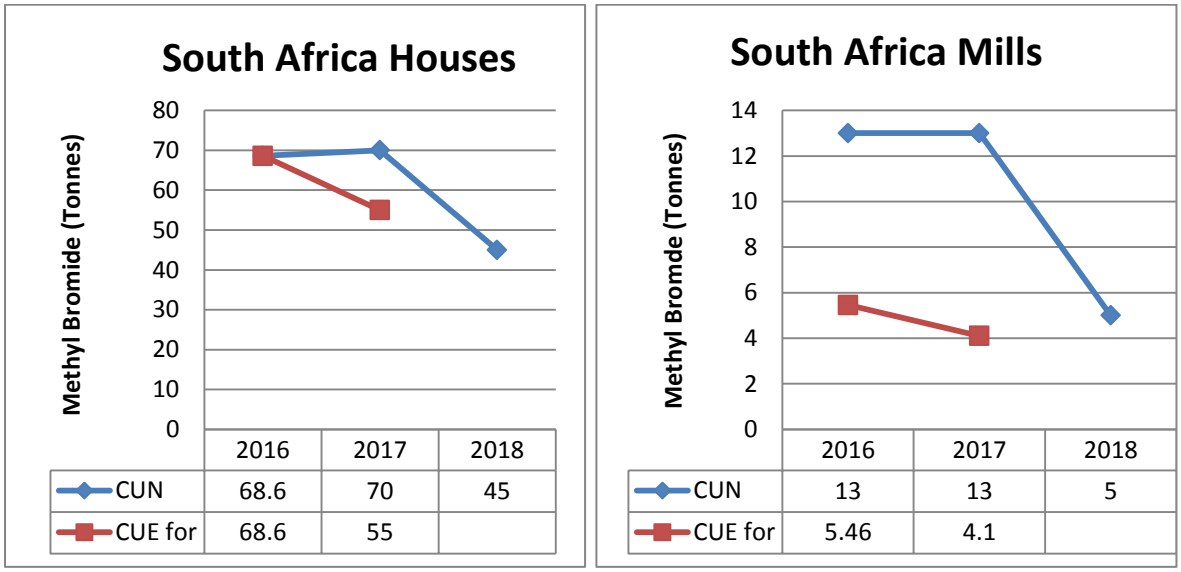


Figure 1.4. Amounts of MB nominated and exempted for CUE uses in structural and commodity uses from 2015 to 2018 by A5 countries: South Africa (RSA). Blue lines indicate the trend in MB amounts nominated in the CUN and the red lines the amount of MB approved as a CUE by the Parties



1.2.6 Article 5 issues

MB was due to be fully phased out in A5 Parties by January 1, 2015, 10 years after the phase out date for non-A5 Parties. In both cases, uses for feedstock and QPS are exempted from phase out under the control measures described in Article 2H. There is also provision for exemption from phase out for uses deemed 'critical' according to Article 2H, as complying with Decision IX/6.

By end of 2015 (the last date for which full official reporting information is available at the Ozone Secretariat Data Access Centre), over 98% of the global consumption for non-exempt uses has been phased out. In A5 Parties, 91.5% of previous controlled uses had been replaced, ahead and in time for the 2015 deadline. This was achieved largely as a result of investment projects implemented by the Montreal Protocol agencies, with MLF funding, bilateral cooperation and also national funding. MBTOC notes that all A5 Parties submitting CUNs in this round (except South Africa) have received substantial funding from the MLF for complete phase-out of MB in their countries by 1st January 2015 at the latest, in many cases earlier.

During communication with parties and industry, MBTOC has become aware of uses of MB for which there is no apparent reporting. MBTOC is concerned that there is a large discrepancy, possibly up to 20,000 t in the emissions determined from the natural and reported uses for controlled uses and the global emissions of methyl bromide (See TEAP Progress Report, 2017). If uses are unreported they could impact the number of critical uses nominated in the future. MBTOC is also concerned that not all parties are aware of the need to report all uses (whether controlled or not) under article 7 reporting and urge the parties to reinforce the mechanisms for reporting and if necessary to provide assistance to parties finding difficulty in reporting.

1.2.6.1. Reporting requirements and agreed conditions under Decision Ex.1/4

Decision Ex. I/4 taken at the 1st Extraordinary Meeting of the Parties (2004) set forth a series of requirements from Parties requesting CUNs after the phase out date, which non-A5 Parties have fulfilled over the past decade and now become relevant for A5 Parties. This Decision also includes some agreed conditions for requesting continuing CUNs.

Such requirements are fully considered by MBTOC during its CUN evaluations and also when preparing the 'Handbook of CUN nominations'. The following list has been prepared to assist A5 Parties with the preparation of CUNs.

The full text of Dec. Ex.I/4 is included in the Appendix II of this report for reference. In synthesis, Parties for which a CUE has been approved need to submit the following materials to the Ozone Secretariat (dates in brackets have been inserted by MBTOC so they apply to the A5 timeline):

1. *Information before 1 February 2005 [2015] on the alternatives available, listed according to their pre-harvest or post-harvest uses and the possible date of registration, if required, for each alternative;*

2. A ***national management strategy*** *for phase-out of critical uses of methyl bromide before 1 February 2006 [2016]. The management strategy should aim, among other things:*

   a) *To avoid any increase in methyl bromide consumption except for unforeseen circumstances;*

   b) *To encourage the use of alternatives through the use of expedited procedures, where possible, to develop, register and deploy technically and economically feasible alternatives;*

   c) *To provide information, for each current pre-harvest and post-harvest use for which a nomination is planned, on the potential market penetration of newly deployed alternatives and alternatives which may be used in the near future, to bring forward the time when it is estimated that methyl bromide consumption for such uses can be reduced and/or ultimately eliminated;*

   d) *To promote the implementation of measures which ensure that any emissions of methyl bromide are minimized;*

   e) *To show how the management strategy will be implemented to promote the phase-out of uses of methyl bromide as soon as technically and economically feasible alternatives are available, in particular describing the steps which the Party is taking in regard to subparagraph (b) (iii) of paragraph 1 of decision IX/6 in respect of research programmes in non-Article 5 Parties and the adoption of alternatives by Article 5 Parties;*

1.2.7 Consideration of Stocks, Decision Ex.1/4 (9f)

One criterion for granting a critical use is that MB "*is not available in sufficient quantity and quality from existing stocks of banked or recycled methyl bromide*" (paragraph 1 (b) (ii) of Decision IX/6). Parties nominating critical use exemptions are requested under decision Ex.I/4(9f) to submit an accounting framework with the information on stocks. MBTOC has not reduced its recommended amount of methyl bromide in consideration of stocks held by the Party and has instead relied on Parties to take this into consideration when approving the amounts recommended by TEAP for each nomination. To assist the Parties with their consideration of stocks, and in accordance with Decision XVIII/13(7), a summary of the data on stocks as reported by non-A5 Parties in the first year for accounting in 2006, and then reports submitted in 2015 and 2016 are summarized in Tables 1.1 to 1.3 below.

Efficient functioning of commerce requires a certain level of available stocks and additional stocks to respond to emergencies. Additionally, stocks may be held on behalf of other Parties or for exempted uses (feedstock and QPS uses). The correct or optimal level of stocks for virtually every input to production is not zero. In addition, stocks are privately owned and may not be readily available for critical uses, or there may be national regulations preventing the transfer of stocks. Despite these restrictions, Parties may wish to ensure that stocks are used wherever possible in order to minimize the quantity of MB that need to be produced each year for critical uses. Tables 1-1 to 1-3 report the quantities of MB 'on hand' at the beginning and end respectively of 2005, 2014 and 2015 as required under Decision Ex. 1/4 (9f). The earlier CUN reports identified stocks for the other years.

Table 1.1. Quantities of MB (metric tonnes) 'on hand' at the beginning and end of 2005, as first reported by Parties in 2006/2007 under Decision Ex 1/4.

Party	Critical use exemptions authorized by MOP for 2005	Quantity of MB as reported by Parties (metric tonnes)				
		Amount on hand at start of 2005	Quantity acquired for CUEs in 2005 (production +imports)	Amount available for use in 2005	Quantity used for CUEs in 2005	Amount on hand at the end of 2005
Australia	146.6	0	114.912	114.912	114.912	0
Canada	61.792	0	48.858	48.858	45.146	3.712
EU	4,392.812	216.198	2,435.319	2,651.517	2,530.099	121.023
Israel	1,089.306	16.358	1,072.35	1,088.708	1,088.708	0
Japan	748	0	594.995	594.995	546.861	48.134
New Zealand	50	6.9	40.5	47.4	44.58	2.81
USA(a)	9,552.879		7,613	not reported	7,170	443

(a) Additional information on stocks was reported on US EPA website, September 2006: MB inventory held by USA companies: 2004 = 12,994 tonnes; 2005 = 9,974 tonnes.

Table 1.2. Quantities of MB 'on hand' at the beginning and end of 2015, as reported by Parties in 2016

Party	Critical use exemption authorized by MOP for 2015	Quantity of MB as reported by Parties (metric tonnes)				
		Amount on hand at start of 2015	Quantity acquired for CUEs in 2015(production +imports)	Amount available for use in 2015	Quantity used for CUEs in 2015	Amount on hand at the end of 2015
Australia	29.76	0	29.75	29.75	29.75	0
Canada	5.261	1.471	4.194	5.665	4.316	1.349
USA	NR					
Argentina	134.3	0	134.15	134.15	134.15	0
China	114.0	0	114.0	114.0	114.0	0
Mexico	84.957	NR	84.9	NR	84.9	NR
RSA	-	-	-	-	-	49.7*

NR= not reported;

*Partly Estimated from supplies available at 30 November, 2015.

Table 1.3. Quantities of MB 'on hand' at the beginning and end of 2016, as reported by Parties in 2017

Party	**Critical use exemption authorized by MOP for 2016**	**Quantity of MB as reported by Parties (metric tonnes)**				
		Amount on hand at start of 2016	**Quantity acquired for CUEs in 2016 (production +imports)**	**Amount available for use in 2016**	**Quantity used for CUEs in 2016**	**Amount on hand at the end of 2016**
Australia	29.76	0	29.75	29.75	29.75	0
Canada	5.261	1.349	4.349	5.598	4.844	0.864
Argentina	129.25	0	129.15	129.15	129.15	0
China	99.75	0	99.75	99.75	99.75	0
RSA	74.062	32	74.062	106.062	65.94	40.068
USA	141	137#	130	267	130	50.0

#Pre 2005 stocks

Table 1-4a. Summary of Critical Use Nominations of Methyl Bromide (tonnes) for non A5 countries

Party	Quantities Nominated														
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Australia	206.950	81.250	52.145	52.900	38.990	37.610	35.450	34.660	32.164	30.947	29.79	29.79	29.79	29.76	28.98
Canada	61.992	53.897	46.745	42.241	39.115	35.080	19.368 +3.529	16.281	13.444	10.305	5.261	5.261	5.261	5.261	
EC	5754.361	4213.47	1239.873	245.00	0	0	0	0	0	0	0	0	0	0	
Israel	1117.156	1081.506	1236.517	952.845	699.448	383.700	232.247	0	0	0	0	0	0	0	
Japan	748.000	741.400	651.700	589.600	508.900	288.500	249.420	221.104	3.317	0	0	0	0	0	
New Zealand	53.085	53.085	32.573	0	0	0	0	0	0	0	0	0	0	0	
Switzerland	8.700	7.000	0	0	0	0	0	0	0	0	0	0	0	0	
USA	10753.997	9386.229	7417.999	6415.153	4958.034	3299.490	2388.128	1181.779 + 6.339	691.608	442.337	377.170	234.78	3.240	0	
Total	**18704.241**	**15617.837**	**10677.552**	**8297.739**	**6244.487**	**4044.380**	**2928.142**	**1460.163**	**740.533**	**483.589**	**412.221**	**269.831**	**38.291**	**35.02**	**[28.98]**

Table 1-4b. Summary of Critical Use Exemptions of MB (tonnes) approved by the Parties for non A5 countries

Party	Quantities Approved													
	2005 (1ExMOP and 16MOP)	**2006 (16MOP+ 2ExMOP+ 17MOP)**	**2007 (17MOP + 18MOP)**	**2008 (18MOP+ 19MOP)**	**2009 (19MOP)**	**2010 (20MOP+ 21MOP)**	**2011 (21MOP)**	**2012 (22MOP)**	**2013 (23MOP)**	**2014 (24MOP)**	**2015 (25 MOP)**	**2016 (26 MOP)**	**2017 (27 MOP)**	**2018 (28 MOP)**
Australia	146.600	75.100	48.517	48.450	37.610	36.440	28.710	31.708	32.134	30.947	29.79	29.79	29.79	29.73
Canada	61.792	53.897	52.874	36.112	39.020	30.340 +3.529	19.368	16.281	13.109	10.305	5.261	5.261	5.261	
EC	4392.812	3536.755	689.142	245.146	0	0	0	0	0	0	0	0	0	
Israel	1089.306	880.295	966.715	860.580	610.854	290.878	0	0	0	0	0	0	0	
Japan	748.000	741.400	636.172	443.775	305.380	267.000	239.746	219.609	3.317	0	0	0	0	
New Zealand	50.000	42.000	18.234	0	0	0	0	0	0	0	0	0	0	
Switzerland	8.700	7.000	0	0	0	0	0	0	0	0	0	0	0	
USA	9552.879	8081.753	6749.060	5355.976	4261.974	3232.856 +2.018	2055.200	993.706	562.328	442.337	376.900	234.780	0	
Total	**16050.089**	**13418.200**	**9160.714**	**6990.039**	**5,254.838**	**3572.183**	**2343.024**	**1261.304**	**610.888**	**483.589**	**411.951**	**269.831**	**35.051**	**[29.73]**

Table 1-4c. Summary of Critical Use Nominations and Exemptions of Methyl Bromide (tonnes) for A5 countries

Party	Quantity nominated				Quantity approved			
	2015	2016	2017	2018	2015	2016	2017	2018
Argentina	245	[223] revised to 177	120.3	120.7	134.3	129.25	102.940	[76.70]
China	120	114	99.75	92.977	114	99.75	92.977	[87.24]
Mexico	140	120.978	0	0	84.96	84.957	0	0
South Africa	-	81.60	83	50	-	74.062	59.10	[45.65]

1.3 Evaluations of CUNs in the 2017 Round for 2018 and 2019 Exemptions

All Parties requesting CUNs in 2017 for critical use exemptions in 2018 or 2019 sent information to the Ozone Secretariat around the January 24, deadline.

Information on CUNs was forwarded by the Secretariat to MBTOC co-chairs, who in turn, provided this information to MBTOC members for preliminary assessment and to confirm that it complied with requirements of Decision IX/6 and Annex 1 of the 16th MOP. Where some evidence was missing, or MBTOC required clarification, a request of the information required was sent to the Parties, via the Secretariat, prior to the interim assessment.

For preplant soil uses of MB, Australia and Canada submitted CUNs for similar amounts as in previous rounds, highlighting difficulties with phase out of MB for the strawberry runners sector specifically. With respect to A5 Parties, Argentina submitted CUNs for the strawberry fruit (open field) and tomato sectors (protected) and China for both protected and field production of ginger.

For MB use in the postharvest and structure sectors, one CUN was received from South Africa for Mills and Houses disinfestation. This nomination required disaggregation by MBTOC in order to be assessed. The two subsectors have different pest complexes and different technical solutions. MBTOC requests that any future nominations be disaggregated by sector in order to be able to assess the nominations efficiently.

The total nominated amount for all countries for 2018 was 268.938 tonnes of which MBTOC made an interim recommendation for 232.770 tonnes (Figs 1.5, 1.11). These recommendations are shown in Table 1.5, 1.11). In 2019, one nomination from Australia applied for a CUE of 28.98 t and MBTOC made an interim recommendation of 23.18 tonnes. One nomination for 2018 (non-A5) remains 'unable to assess' at this time. The grounds used for these recommendations are given in detail for the relevant CUNs in Tables 1.9, 1.10 and 1.11.

In general the justification for CUNs being submitted by parties related to the following alleged issues: environmental conditions and regulatory restrictions did not allow partial or full use of alternatives, difficulties in the scale-up of alternatives and that potential alternatives were considered uneconomical, insufficiently effective and/or were unavailable. In paragraph 20 of Annex 1 referred to in Decision XVI/4, Parties specifically requested MBTOC to explicitly state the specific basis for the Party's economic statement relating to CUNs. Tables 1.9, 1.10 and 1.11 provide this information for each CUN as prepared by the MBTOC economist and the MBTOC members. MBTOC notes the standard of the economic information supplied by the nominating Parties varied.

MBTOC notes that all Parties responded to questions on time and promptly before the MBTOC meeting.

Detailed interim assessments of all CUNs were conducted by MBTOC at a meeting in Durban, Republic of South Africa from 3-8 April 2017. Most (15 out of 16) MBTOC members with expertise in soils, SC and QPS applications of methyl bromide attended the meeting. MBTOC worked as a single committee, not in sub-committees. The three co-chairs appointed working groups to address the different tasks assigned to MBTOC including CUNs, but also others as included in its Progress Report. Recommendations were discussed and signed off in plenary and by consensus. Comments made via email by one member not attending the meeting were considered. This scheme allowed members with specific expertise to make contributions where they were most useful and for all the committee to fully participate in the decision making process.

MBTOC conducted two field visits to structure and commodity sectors in RSA. The first was to a mill near Johannesburg on the 3rd April and the second to houses infested by insects around Durban on the 5th April. At both of these meetings presentations were given by the party and industry on issues related to the CUN uses of MB and alternatives. MBTOC further held a bilateral meeting in

Durban with South African government representatives, including the National Ozone Unit, the Ministry of Agriculture and the Ministry of the Environment, to further clarify the particular circumstances of their CUNs.

1.3.1 Critical Use Nomination Review Process

The meeting was held as required in accordance with the time schedule for the consideration of CUNs provided in Annex I referred to in Decision XVI/4. In assessing the CUNs submitted in 2017, as in previous rounds, MBTOC applied as much as possible the standards contained in Annex I of the final report of the 16thMOP and, where relevant, the standard presumptions given below. In particular, MBTOC sought to provide consistent treatment of CUNs within and between Parties while at the same time taking local circumstances into consideration. The most recent CUE approved by the Parties for a particular CUN was used as baseline for consideration of continuing nominations. In evaluating CUNs for soil treatments, MBTOC assumed that the presence of a technically feasible alternative to MB would need to provide sufficient pest and/or weed control to allow for continued production of that crop within existing market standards. The economic viability of production was also considered.

For commodity and structural applications, it was assumed that technically and economically feasible alternatives would provide disinfestation to a level that met the objectives of a MB treatment, e.g. meeting disinfestation standards in treated structures or mills. It was confirmed that the certification accreditation requirements did not specifically require the use of methyl bromide.

The outcome of evaluations of CUNs for the soil and structural treatments are presented in Table 1.9, 1.10 and 1.11 below.

1.3.2 Achieving Consensus

In accordance with Decision XX/5(9) and subsequent Decisions (XXI/11(4), XXII/6(4) and XXIII/4(3) and XXIV/5 and 8) the Parties have indicated that MBTOC '*should ensure that it develops its recommendations in a consensus process that includes full discussion among all available members of the Committee….'*

In keeping with this mandate as well as the new working scheme put in place by the co-chairs, all members were given access to the information and were able to discuss issues related to all nominations (either in person or by electronic means), but only those members able to physically participate in the meeting formed consensus. All views were discussed fully in plenary and issues debated until a consensus position was reached. No minority positions arose during the meeting.

Several members recused from recommendations on nominations as required by MBTOC's working procedures. These included Alejandro Valeiro (recusing from Argentina strawberry fruit and tomato), Cao Aocheng (China ginger) and Ian Porter (Australian strawberry nurseries). Recusals took place either as a result of a member's disclosure in observance of MBTOC's guidelines or due to a voluntary self-recusal to avoid any perceived conflict of interest.

1.4 Interim Evaluations of 2017 Critical Use Nominations for Methyl Bromide for Preplant soil use in 2018 and 2019

1.4.1 Critical Use Nomination Assessment

Table 1.5 identifies the quantities recommended by MBTOC after consideration of all the information provided by the Parties requesting critical uses. In summary, the Australian nomination was reduced as it was considered that the Party should seek to reduce the dosage rate to conform to MBTOC's standard presumptions. The Canadian nomination was considered 'unable to assess' as MBTOC is seeking direction from parties in how to assess the nomination in compliance with Decision IX/6. The Argentinean tomato and strawberry nominations were reduced because it was considered that alternatives were available for a proportion of the nominations and dosage rates could be reduced to conform with MBTOC's standard presumptions, with VIF. The open field ginger nomination from China was reduced to conform to adoption of barrier films on 100% of the nominated area whilst the nomination for protected cropping was recommended in full on the basis that the party had indicated its intention to phase out methyl bromide for the entire ginger sector. Further clarification will be required if subsequent CUNs are submitted. The detailed descriptions can be found in Table 1-5.

Table 1-5. Summary of the interim recommendations (in square brackets) for CUE's for preplant uses of MB (tonnes) submitted in 2017 for 2018 and 2019

Country and Sector	Article 5 Parties		Non A5 Parties	
	Nomination by Party for 2018	**Interim Recommendation for 2018**	**Nomination by the Party for 2019**	**Interim Recommendation for 2019**
1. Australia				
Strawberry runners			**28.98**	**[23.18]**
2. Canada				
Strawberry runners	**5.261**	**[Unable]**		
3. Argentina				
Tomato	**75.4**	**[47.70]**		
Strawberry fruit	**45.3**	**[29.00]**		
4. China				
Ginger, open field	**74.617**	**[68.88]**		
Ginger, protected	**18.36**	**[18.36]**		
TOTAL	**218.938**	**[163.94]**	**28.98**	**[23.18]**

1.4.2 Issues Related to CUN Assessment for Preplant Soil Use

Key issues which influenced assessment and the need for MB for preplant soil use of MB in the 2016 round were:

i) For all nominations, except Australia, barrier films were considered as a technology to reduce rates and emissions of methyl bromide. For Australia, the Party presented data illustrating that heavy soil types trap methyl bromide as effectively with LDPE films as barrier films under the circumstances of the nomination. However, MBTOC seeks justification as to why regulations indicating dosage rates above MBTOC's standard presumptions cannot be modified (ie substantiation that such lower dosage rates are not effective).

ii) The Australian research program is trialling many options for replacement of MB in strawberry runners and updated MBTOC during the 38thOEWG in 2016 of progress.

iii) The Canadian nomination has been relying on a groundwater study to determine whether Pic (a key alternative) can be granted a permit for use on Prince Edward Island, but this study has not gone ahead and the grounds for banning Pic as a groundwater contaminant are unclear.

iv) The Argentinian nominations are for sectors where a number of alternatives have been adopted in all A5 and non A-5 Parties, however specific issues with cold soils and market windows are of concern for uptake of the major alternatives. A key pest of tomato, the *Nacobbus* (false root-knot) nematode is requiring specific consideration as no resistant rootstocks with good commercial potential have been identified for this pest.

v) China has obtained positive results in the ginger sector with chloropicrin, but further controls are required to address nematodes and weed issues. Research shows good results with 1,3-D/Pic and DMDS/Pic, but these fumigants are currently not registered in China.

MBTOC has noted more specific issues related to requests for CUNs below and also in the CUN text boxes (Table 1.9).

1.4.3 General Comments on the Assessment for Preplant Soil Use

MBTOC continues to encourage Parties to consider a review of regulations covering the registration, use and adoption of alternatives, including those regarding barrier films to reduce dosage rates of MB and its alternatives, and associated emissions. MBTOC also notes that a proportion of MB has been nominated for uses where regulations or legislation prevent reductions of MB dosage and encourages Parties to review such regulations where possible. For several cases, the mandatory use of MB is specified at a high dosage, in some cases for treatment of certified propagation material. Also regulations on the use of alternatives or their lack of registration are preventing their uptake for a substantial proportion of the remaining CUNs for preplant soil use.

1.4.4 Registration of Alternatives for Preplant Uses - Decision Ex I/4 (9i) and (9j)

Decision Ex. I/4 (9i) requires MBTOC, "*To report annually on the status of re-registration and review of methyl bromide uses for the applications reflected in the critical-use exemptions, including any information on health effects and environmental acceptability"*. Further, Decision Ex I/4 (9j) requires MBTOC "*To report annually on the status of registration of alternatives and substitutes for methyl bromide, with particular emphasis on possible regulatory actions that will increase or decrease dependence on methyl bromide".*

Where these have impacted a nomination, the Party or MBTOC may have adjusted quantities to allow for effective use of the alternative. A description of any changes has been made available in the CUN text boxes (Tables1.9 and 1.11).

Any future nominations submitted by any Party should include information on expected rates of adoption of alternatives following registration, in accordance with paragraphs 34-35 of Annex 1 of the 16thMOP, as this information would assist MBTOC in its evaluation of these CUNs.

1.4.5 Decision XXV/4

In response to Decision XXV/4 from the 25th MOP, MBTOC notes that all of the non-A5 nominations contained a discussion of national, subnational or local regulations impacting the potential use of alternatives to MB. In addition, both Non-A5 and A5 nominations contained information on the status of the registration of alternatives and substitutes for MB. These comments are summarized below for each Party.

1.4.5.1. Regulations impacting use of alternatives by country

- **Australia:** Several promising alternatives have been identified. TriForm-80® (1,3-D/Pic, 20:80) showed great promise in trials in reducing the risk of phytotoxicity occurring in strawberry runners in Toolangi, Victoria, but is not technically feasible on its own as it does not control pathogens and weeds as effectively as MB/Pic. Co-application with herbicides, i.e. isoxaben and phenmedipham gave excellent results but these are not yet registered for strawberry runners in Australia.

- **Canada**: A groundwater warning statement is currently on Canadian labels, which prevents the use of all fumigant alternatives in PEI, however no testing of Pic is, or has been, conducted to verify the concerns. Methyl bromide + Pic is allowed, in spite of 33% concentration of Pic.

- **China**: In addition to chloropicrin, China has registered several new chemicals on ginger including dazomet and Bordeaux mixture (Cu(OH)2 + CaSO4). These chemicals alone or in combination, may control efficiently fungal, bacterial and nematodes diseases of ginger, but need further evaluation. DMDS is expected to be registered in 2018. Pendimethalin has been tested as herbicide as alternative to MB but this does not control nematodes and weeds.

- **Argentina**: Chloropicrin is not registered as a stand-alone product in Argentina, but combinations of 1,3-D/pic products are registered. Dazomet is not registered for edible crops. A regulation in Mar del Plata bans 1,3-D/Pic use (however it is still used in some cases)

- **South Africa**: No fumigant alternatives to methyl bromide are yet registered for mills and houses, however registration of sulfuryl fluoride and EDN are under way.

1.4.5.2 Health effects of MB use and environmental acceptability

Over the past two decades numerous studies have characterized the health hazards resulting from exposure to methyl bromide. Its acute and chronic toxicities are very high and in many countries it is classified as "toxicity class I". It is known as a developmental, neurologic and respiratory toxin (Gemmill *et al*., 2013, De Souza *et al*., 2013, Bulathsinghala and Shaw, 2014). Other known target organs are the heart, adrenal glands, liver, kidneys and testis (Gemmill *et al*., 2013).

Accidental exposure to high concentrations of MB has been reported in many instances including fumigation of museums in Japan (Yamano and Nakadate, 2006), when handling the fumigant in a manufacturing facility in India (De Souza *et al*., 2013), when opening imported freight containers (Baur *et al*., 2010) and even in a home used for vacations (Sass, 2015).

Research findings reinforce suggested links between exposure to MB and health problems, including increased risk of developing prostate cancer, derived from occupational and community exposure (Budnik *et al*., 2012, Cockburn *et al.*, 2011). In another study (Gemmill *et al*., 2013), a correlation was found between impaired foetal growth during the third trimester and exposure to methyl bromide in residential areas. A recent study focused on toxicity effects from chronic use of methyl bromide, finding that effects of exposure at what are believed to be safe and appropriate concentrations of methyl bromide under federal guidelines are under-reported and not previously present in the literature. Patients included in this study developed similar syndromes of ataxia, urinary retention and psychiatric symptoms that were matched by unique abnormalities on MR imaging of the brain and serum lab abnormalities (McCall *et al*, 2016).

Risk of exposure is especially high when small disposable canisters (i.e. 500 to 750 g) are used for MB fumigation for pre plant soil under plastic sheets (Yamano *et al*., 2001). Canister applications have been eliminated for soil use in all non-Article 5 and in many A5 countries as this application is considered to be less efficient than other methods for the control of soil borne pathogens. Besides, this treatment is considered to be more dangerous to workers than injection methods, because trained contractors are not generally involved in MB application. This practice is not considered as effective for pathogens' control as injection of MB/Pic mixtures and also can lead to high emissions of MB as the gas is released immediately beneath the plastic sheets. MB also notes that in some circumstances, MB can sometimes leak out from the canister. MBTOC notes with concern that canister use is still allowed for preplant use and /or quarantine uses in a number of A5 countries e.g. China, Egypt, Jordan and Mexico, sometimes including for QPS situations.

The environmental acceptability of MB is handled by national regulatory authorities in each country**.**

1.4.6 Sustainable Alternatives for Preplant Uses

MBTOC urges Parties to consider the long-term sustainability of treatments adopted as alternatives to MB. The combination of chemical and non-chemical alternatives in an IPM program provides excellent results in the longer term. Decision IX/6 1(a)(ii) refers to alternatives that are '*acceptable from the standpoint of environment and health'*. MBTOC has visited various regions where successful non-chemical alternatives e.g. soil less culture, grafting, solarisation, steam, bio-disinfestation (biofumigation) and anaerobic soil disinfestation, are used as sustainable alternatives to MB. Several Parties consider these techniques as viable alternatives, particularly when an integrated approach that combines different options is adopted.

1.4.7 Standard Presumptions Used in Assessment of Nominated Quantities

The tables below (Tables 1-6 and 1-7) provide the standard presumptions applied by MBTOC for this round of CUNs for preplant soil uses. These standard presumptions were first proposed in the MBTOC report of October 2005 and were presented to the Parties at the 17th MOP. Studies and reports to support them have been provided in previous reports and were revised for some sectors after consideration by the Parties at the 19th MOP. The rates and practices adopted by MBTOC as standard presumptions are based on maximum rates considered acceptable by published literature and actual commercial practice.

As in the evaluations in previous years, MBTOC considered reductions to quantities of MB in particular nominations to a standard rate per treated area where technical evidence supported its use. As a special case, MBTOC continues to accept a maximum rate of 200 kg/ ha (20 g/m^2) in MB/Pic formulations with high Pic-containing mixtures with or without barrier films for certified nursery production, unless regulations prescribe lower or higher rates. However, MBTOC notes that studies have shown that rates of 200 kg/ha (20g/m^2) or less of MB: Pic 50:50 are effective with barrier films for production of 'certified' nursery material and urge Parties to consider regulations which permit these lower rates. MBTOC also notes that certified runner production may involve regulations which specify the mandatory use of a fumigant such as MB or an alternative, in order for the runners to be "certified runners".

The indicative rates used by MBTOC were maximum guideline rates, for the purpose of calculation only. MBTOC recognises that the actual rate appropriate for a specific use may vary with local circumstances, soil conditions and the target pest situation. Some nominations were based on rates lower than these indicative rates.

Table 1.6. Standard Presumptions Used in Assessment of CUNs for Preplant Soil Use of MB

	Comment	CUN adjustment	Exceptions
1. Dosage rates	Maximum guideline rates for MB:Pic 98:2 are 25 to 35 g/m^2 with barrier films (VIF or equivalent); for mixtures of MB/Pic are 12.5 to 17.5 g MB/m^2 for pathogens and nutsedge respectively, under barrier films depending on the sector. All rates are on a 'per treated hectare' basis.	Amount adjusted to maximum guideline rates. Maximum rates set dependent on formulation and soil type and film availability.	Higher rates accepted if specified under national legislation or where the Party had justified otherwise.
2. Barrier films	All treatments to be carried out under low permeability barrier film (e.g. VIF, TIF)	Nomination reduced proportionately to conform to barrier film use.	Where barrier film prohibited or restricted by legislative or regulatory reasons
3. MB/Pic Formulation: Pathogens control	Unless otherwise specified, MB/Pic 50:50 (or similar) was considered to be the standard effective formulation for pathogen control, as a transitional strategy to replace MB/Pic 98:2.	Nominated amount adjusted for use with MB/Pic 50:50 (or similar).	Where MB/Pic 50:50 is not registered, or Pic (Pic) is not registered
4. MB/Pic Formulation: Weeds/nutsedge ass control	Unless otherwise specified, MB/Pic 67:33 (or similar) was used as the standard effective formulation for control of resistant (tolerant) weeds, as a transitional strategy to replace MB/Pic 98:2.	Nominated amount adjusted for use with MB/Pic 67:33 (or similar).	Where Pic or Pic-containing mixtures are not registered
5. Strip vs. Broadacre	Fumigation with MB and mixtures to be carried out under strip	Where rates were shown in broad acre hectares, the CUN was adjusted to the MB rate relative to strip treatment (i.e. treated area). If not specified, the area under strip treatment was considered to represent 67% of the total area.	Where strip treatment was not feasible e.g. some protected cultivation, emission regulations on MB, or open field production of high health propagative material

Table 1.7. Maximum dosage rates for preplant soil use of MB by sector used since 2009 (standard presumptions).

Film Type	Maximum MB Dosage Rate (g/m^2) in MB/Pic mixtures (67:33, 50:50) considered effective for:			
	Strawberries and Vegetables	**Plant Nurseries***	**Orchard Replant**	**Ornamentals**
Barrier films - Pathogens	12.5	15	15	15
Barrier films – Nutsedge	15.0	17.5	17.5	17.5
No Barrier films – Pathogens	20	20	20	20
No Barrier films - Nut sedge	26	26	26	26

* Maximum rate unless certification specifies otherwise

1.4.8 Adjustments for Standard Dosage Rates using MB/Pic Formulations

As in previous assessments, one key transitional strategy to reduce MB dosage has been the adoption of MB/Pic formulations with lower concentrations of MB (e.g. MB/Pic 50:50, 33:67 or less). These formulations are considered to be equally as effective in controlling soilborne pathogens as formulations containing higher quantities of MB (e.g. 98:2, 67:33) (Porter *et al.*, 2006; Santos *et al.*, 2007; Hamill *et al.*, 2004; Hanson *et al.*, 2006), (Table 1.8).

Table 1.8. Actual dosage rates applied during preplant fumigation when different rates and formulations of MB/Pic mixtures are applied with and without barrier films. Rates of application reflect standard commercial applications rates.

Commercial application rates (kg/ha) of MB/Pic formulation	**MB/Pic formulation (dose of MB in g/m^2)**			
	98:2	**67:33**	**50:50**	**30:70**
A. With Standard Polyethylene Films				
400	39.2	26.8	20.0	12.0
350	34.3	23.5	17.5	10.5
300	29.4	20.1	15.0	9.0
B. With Low Permeability Barrier Films (LPBF)				
250	24.5	16.8	12.5	7.5
200	19.6	13.4	**10.0***	6.0
175	17.2	11.8	8.8	5.3

** Note: Trials from 1996 to 2008 (previous CUN reports) show that a dosage of 10g/m^2 (e.g. MB/Pic 50:50 at 200kg/ha with Low Permeability Barrier Films) is technically feasible for many situations and equivalent to the standard dosage of >20g/m^2 using standard PE films*

1.4.9 Use/Emission Reduction Technologies - Barrier films and dosage reduction

Decision XXI/11 (para. 9) requested further reporting on Decision IX/6 to ensure Parties adopted emission controls where possible. For preplant soil use, this includes the use of barrier films or other mitigation strategies such as high moisture sealing and the lowest effective dose of MB with mixtures of chloropicrin. Other methods include deep shanking and use of ammonium thiosulphate and different irrigation technologies (Yates *et al.*, 2009). These latter technologies have not been reported or adopted widely by Parties.

In southeast USA the reported use of barrier films in vegetable crops, which expanded rapidly to over 20,000 hectares in 2009 has continued to increase. A change in the regulations – presently allowing use of VIF in California - leaded to an increase in the adoption of barrier films in that State. MBTOC notes that barrier films particularly more recently developed totally impermeable (TIF) films can be used with alternatives and this is consistently improving the performance of alternatives at lower dosage rates (Driver *et al*. 2011; Cabrera *et al.*, 2015). For example, effectiveness at lower dosages can allow for greater areas to be treated with 1,3-D under township cap regulations.

As of December 1, 2012, EPA issued new set of soil fumigant product label changes, implementing important new protections for workers and bystanders. In the frame of these changes, the State of California now allows the use of VIF films for fumigation with MB, which were formerly prohibited (CDPR, 2014;). Studies continue to show the advantages of barrier films and other technologies for reducing emissions and improving efficacy of alternatives as well as MB (Cabrera *et al.*, 2015, Weilland *et al*, 2016).

Table 1-9. Interim recommendations for CUNs from non A5 Parties for preplant soil use submitted in 2017 for 2018 and 2019

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUE for 2014 [10]	CUE for 2015[11]	CUE for 2016[12]	CUE for 2017	CUE for 2018	CUN for 2019	MBTOC interim rec0mmendation for 2019
Australia	Strawberry runners	35.750	37.500	35.750	35.750	29.790	29.790	29.790	29.760	29.760	29.760	29.760	29.760	29.760	29.760	28.98	[23.18]
		MBTOC interim recommendation for 2019 MBTOC recommends a reduced amount of 23.18 tonnes for 2019 for this nomination. This is a 20% reduction of the nominated amount, based on MBTOC's standard presumptions; MBTOC urges the party to revisit regulations which allow for either a reduction in the dosage rate of MB to conform to said presumptions and/or revision of certification rules to allow for greater adoption of any effective alternatives. MBTOC is aware that current regulations and new technologies with barrier films etc. may need to be revisited. The combination of particular environmental conditions (e.g. soil type, temperatures, wind), together with a small-size economic sector (10 growers with 119 ha) and very strict and rigid regulations (e.g. registration requirements, minimum dosages, runners´ certification system) constitute a huge barrier for implementing alternatives for this particular use. After 14 years of CUEs of MB for this use in Australia, MBTOC feels that even the continuous recommendation–as it almost guarantees MB supply to these growers- could have in itself become a barrier for technological change and adoption of alternatives. MBTOC recognizes the Party´s continuing efforts to find alternatives, and that good progress has been achieved with some options presently under research (e.g. new application technologies for MITC generators; formulations of 1,3-D/Pic (TF-80®); new herbicides; EDN; DMDS, MI or even microwave.). **Nomination by the Party:** The Party nominated 28.98 tonnes to treat 119 ha (at a dose rate of 25 g/m2). This small reduction (0.78 tonnes) in the nominated amount is the first since 2009 and it is due to the transition of mother stock (third generation) production without the use of MB. The Party states that Certified runners (fourth generation) still have no technically and economically available alternatives. **Circumstances of the nomination by the Party:** The Party states that the key pests affecting strawberry runner production are fungi (*Phytophthora, Pythium, Rhizoctonia* and *Verticillium spp.)* and weeds (*S. arvensis*, *Agrostis tenuis*, *Raphanus spp*., *Poa annua*, *Cyperus spp*). The nomination is based on a particular soil type and temperature situation: soils with very high clay and organic matter content requiring fumigation treatment under cold temperatures. In its CUN the Party arguments that runner production under such conditions, requires treatment with MB:Pic (50:50 at a MB dosage of 25 g/m2) to meet the certification standards. The other registered soil fumigants, such as 1,3-dichloropropene (1,3-D)/Pic (65:35), cause crop phytotoxicity and yield losses of up to 40%. Phytotoxicity is related to the high organic matter (5-10%) and clay content (> 50%) of soils at Toolangi, and the long residual times of alternative fumigants in these soils (Mattner *et al.*, 2014). The Victorian runner industry only produces runners in soils treated with MB:Pic, and is not using any other methods other than substrates for the foundation stock production stage (Mattner *et al.,* 2015) . Some non-chemical alternatives are not feasible. Plant resistance is unreliable as an alternative to MB:Pic for delivering certified runners (Fang *et al*., 2012). Integrated soil disinfestation with combinations of existing registered fumigants and not yet registered herbicides now appears															

		as the most likely approach for delivering a viable alternative to MB for the runner industry. The concept of the strategy is to apply low doses of existing registered fumigants (e.g. Pic, 1,3-D, and MITC generators) and herbicides (e.g. isoxaben, metolachlor, napropamide) in combinations that avoid potential crop phytotoxicity. TF-80® (1,3-D/Pic, 20:80) showed great promise in trials in reducing the risk of phytotoxicity occurring in strawberry runners in Toolangi, Victoria because of its low concentration of 1,3-D. However, TriForm-80 (recently registered) is not technically feasible on its own because it does not control pathogens to the same soil depth, and weeds as effectively as MB/Pic. Runners produced in soils treated with TriForm-80 in the nursery subsequently produced 15% lower fruit yields than runners produced in soils treated with MB/Pic in the nursery. Co-application of alternative fumigants (Pic Plus® and TF-80®) with the herbicides isoxaben and phenmedipham increased weed control and runner yields in replicated trials to levels equivalent to MB/Pic. But these herbicides are not yet registered for use in the strawberry industry in Australia. Further, even if registered, nor TF-80® or the herbicides would be an option for runner growers because they first would need to be approved by VSICA (certification authority). Along its history, VSICA has only approved MB/Pic as a treatment for runners. Its arguments are that high levels of pathogen control are essential for production of certified high health runners to manage the risk of litigation. Although the MB dosage rate exceeds MBTOC's standard presumption of 20 g/m2, the lower rate is still unregistered in Australia and there seems to be no hope to change it after 14 years of MBTOC suggestions. According to the Party, three years of trials with lower MB rates do not support bio-equivalency of these rates. These experiments were conducted over a decade ago and MBTOC believes technologies have improved since then. Trials conducted since 2014 in Australia with dimethyl disulphide (DMDS) particularly when co-applied with other fumigants or herbicides (Mattner *et al.,* 2015; included in the CUN) have shown that treatment with DMDS and DMDS/Pic significantly reduced the total populations of soil borne pathogens by up to 95% reduced weed emergence by up to 70% and increased runner yields by up to 45%. The plant-back time required for DMDS and DMDS/Pic was 3 wk which was comparable to MB/Pic and Pic (2.5 wk), and shorter than 1,3-D-/Pic and Pic + Daz (6-12 wk). These results clearly show that, in Australia, DMDS and DMDS/Pic have considerable potential for soil disinfestation and runner production (Mattner *et al.*, 2015). Application of dazomet well in advance of DMDS fumigants shows a higher efficacy. In California, steam is currently considered as alternative soil disinfestation method for strawberry production. Steam has shown similar pest and weed control efficacy than common chemical and non-chemical soil disinfestation methods () and there are options to make this alternative economically feasible (Hoffman *et al.*, 2015). **MBTOC interim assessment for MB use in this sector in 2019:** MBTOC still considers that soilless culture is a technique used widely for production of strawberry runners and is technically and economically suitable for some of the certified nursery production system as well as stock plants resulting in healthy nursery material (López-Galarza *et al.,* 2010, Rodríguez-Delfín 2012). In a recent paper (Lopez Aranda *et al.*, 2016) conducted a comprehensive survey of 41 strawberry industries in European and other countries. Over 5,755 ha of strawberry nurseries were assessed, with different soils and climate situations. The survey showed that 32% of the acreage studied is fumigated with metham sodium (spading), 31% uses crop rotation (with cereals, grasses, oilseed crops, legumes, and other crops as green manure, such as oil radish, mustards, winter rye, and buckwheat) and/or change of location only; 19.3% is fumigated with 1,3D:Pic and/or 1,3D+Chloropicrin; 8.6% relies on non-chemical methods (cover/catch crops, soil solarization, and ASD), 7.2% on fumigation with dazomet (Mix-Tiller), and the rest (1.9%) on other chemical solutions. None of the nurseries use MB. While MBTOC once more recognizes the Party's continued efforts in researching and developing an array of MB alternatives, it is also true that these efforts have not resulted in any commercial uptake of alternatives. Furthermore, there have been essentially no significant reductions made for this production region since 2005 and no change in the VSICA certification rules. MBTOC commends Australia for renewed research efforts (in line with Decision XXV/4), which are showing promising results and for urgently putting forward a plan for phasing-out MB use that could not be yet achieved.

		The combination of particular environmental conditions (e.g. soils, temperatures, winds), together with the sector's small size (10 growers and 119 ha) and very strict and apparently unchangeable regulations (e.g. registration requirements, minimum dosages, runners´ certification system) seem to be a huge barrier for the implementation of alternatives for this particular use. After 14 years of granting MB exemptions for this use in Australia, MBTOC even feels that its continuous recommendation virtually guarantees MB supply to these growers and could in itself be becoming a barrier for technological change and adoption of alternatives. A recent study (Guthman; 2016) in reference to the California strawberry industry suggests that *"…CUEs induced complacency in the industry, giving growers hope that the exemptions would persist and slowing down the development and testing of other alternatives, including less toxic alternatives…*" even putting the industry in a weak position, with no scalable solutions for soil pathogens on the immediate horizon. MBTOC urges the Party to review regulations and other hurdles to the adoption of alternatives, which seem to be stalling the phase-out process. MBTOC understands that certification authorities require at least two years of data demonstrating alternatives deliver equivalent efficacy to MB/Pic before changes to the rules of the Certification Scheme could be granted, but urges the Party to be more flexible with regulations and accelerate the schedule in order to phase out MB as soon as possible. This will be in line with the situation of various countries around the world who phased-out MB use in strawberry runners in the past and have implemented alternatives successfully (García-Sinovas *et al.,* 2014; López-Aranda, 2016). **MBTOC comments on economics provided in CUN for 2019:** Previously, it was believed that while the Foundation stock can be grown in a soil-less system, Mother and Certified stocks could not. However new research shows that improved production methods can increase the productivity of soil-less systems for runner production. These systems are based on the use of hydroponics for tip production, and plug plants for transplant production within screen houses. Previous partial budget analysis was based on the use of soil-less substrates in large bins for production of bare-rooted transplants. Under the current price of runners, production of Mother Stock as plug plants would result in a net revenue loss per hectare of A$ 920,000. Prices of Mother Stock needs to increase from A$0.34 per runner to A$1.01 for hydroponic production systems to break even. However, the increased cost for Mother stock could be absorbed into the cost of Certified stock runners. Results showed that adoption of the hydroponics system in the Mother generation would require a price increase of A$0.01 per runner in the Certified generation. Therefore, the use of the hydroponic system is considered economically feasible for the Mother generation of runners. **Comments Requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b (i) Emission reduction:** No, but the Party states that standard films perform the same as VIF for the reduction of emissions in the cold temperatures and heavy wet soils typical for strawberry runner production in Victoria. Party also states that use of VIF did not improve the efficacy of reduced rates of MB to an acceptable level for the strawberry runner industry. • **Dec. IX/6 b (ii) Research program:** Approved and funded research program is currently in place at the time of this nomination. • **Dec. IX/6 b (iii) Appropriate effort:** Research effort is adequate - funded research program currently in place at the time of this nomination.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUE for 2014[10]	CUE for 2015[11]	CUE for 2016[12]	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018
Canada	Strawberry runners (PEI)	6.840	6.840	7.995	7.462	7.462	7.462	5.261	5.261	5.261	5.261	5.261	5.261	5.261	5.261	[Unable]

MBTOC interim recommendation for 2018:

MBTOC is unable to assess the nomination.

In the absence of progress in the adoption of other alternatives, MBTOC is concerned that a key chemical alternative, chloropicrin (Pic) is presently allowed to be used in mixtures with methyl bromide, but its use alone or in combination with other alternatives is banned (and thus progress to phase out MB) due to concerns over groundwater contamination in PEI.

In response to MBTOC's questions and through efforts to address these concerns, the party provided a detailed list of results of monitoring non-fumigant chemicals in groundwater (fungicides, insecticides and herbicides), however no data was provided for any fumigants, including chloropicrin. This same request has been made by MBTOC for several years. During the MBTOC meeting, the party confirmed that chloropicrin is not being monitored and thus the situation with Pic use in MB mixtures and the adoption of Pic as an alternative cannot be resolved. In further follow up with the party, they explained that in discussions with both the grower and the province, PIC was omitted from the list because the location and capability of the laboratories did not allow for PIC tests. It appears there is no legislation preventing the use of chloropicrin, aside from a statement on the label warning of its potential groundwater contamination. MBTOC is concerned that the arguments provided by the Party about groundwater contamination by chloropicrin (and other fumigants) in PEI are not being adequately addressed.

In view of this situation, MBTOC is unable to assess this nomination and needs guidance from the parties as to how to assess this nomination.

MBTOC recognizes the efforts to expand adoption of substrates for later production stages and urges the Party to expedite these research efforts to secure alternatives as indicated by Dec. IX/6 b (iii).

These will be considered by MBTOC, together with any additional information during its final assessment.

In past rounds, MBTOC has consistently urged the Party to consider the use of 100% chloropicrin with herbicides as a feasible alternative for MB under Dec. IX/6 for this nomination involving a single grower. On March 10th 2017, the special review conducted by Canada's regulatory authority (PRMA) (REV 2017-04) allowed continuation of registration of chloropicrin throughout in Canada, but restrictions still exist in PEI to prevent its use. For several years, the Canadian nomination has been relying on a groundwater study to determine whether chloropicrin (PIC) can be considered or not as an alternative to MB for use in PEI. As stated in last years' CUN, The study was terminated as a result of a special review initiated by the Pest Management Regulatory Agency (PMRA) and the Party has advised that Pic will no longer be considered for use in PEI even if the Federal review was successful.

The CUN also states that several Canadian strawberry runner growers in other provinces, such as Ontario, Quebec and Nova Scotia, have adopted chloropicrin or metham sodium to assist with phase out of methyl bromide. The Party further states that the grower was interested in testing PIC alone in its fields, evidenced by their repeated requests for chloropicrin use permits in past CUNs. However, the government of PEI has been unable to authorize the PIC trials or those with any of the other chemical fumigant alternatives because of potential of groundwater contamination.

		Nomination by the Party for 2018: The Party has nominated 5.261 t of MB, which is the same amount granted as a CUE for 2017 and for all previous years CUEs since 2011 for this one company. It is for use for multiplication on runners on 26.3 ha of land, which includes the two final stages of multiplication of plants exported from PEI. The nomination is based on a reduced rate of MB of 20 g/m² (instead of 50 g/m^2) under high barrier films for the entire fumigated area, which is consistent with MBTOC's standard presumptions. **Circumstances of the nomination by the Party**: The grower has attempted to replace MB with 1,3-D in the past, but this fumigant was banned for use in Prince Edward Island in January 2003 due to potential ground water contamination. Several Canadian strawberry runner growers in other provinces such as Ontario, Quebec and Nova Scotia, phased out methyl bromide by using chloropicrin. Chloropicrin (PIC 100) is registered in Canada, but the PEI authorities have denied a permit for its use until further groundwater testing has been conducted. Long awaited studies on potential groundwater contamination of Pic 100 finally commenced in December 2013. Following the launch of the study, Health Canada's Pest Management Regulatory Agency (PMRA) initiated a special review of chloropicrin as a result of the European Union's decision to prohibit its use. In June 2014, PEI authorities informed Environment Canada that they would not authorize the use of chloropicrin through the issuance of a research permit as part of the groundwater monitoring study until the PMRA's special review is completed. Given that the study cannot proceed without a research permit from the PEI Government to use chloropicrin, the study has been put on hold. On May 21, 2015, the PMRA published a document entitled Pest Management Regulatory Agency Re-evaluation Work Plan 2015-2018. A literature review of chloropicrin from major agricultural use in California and Florida indicates that chloropicrin is not detectable in groundwater. In addition, chloropicrin was not detected in the two groundwater samples collected on PEI in 2009. The company at PEI has tested organic production from 2006 - 2009 with different varieties but found that significant reductions in yield resulted, ranging from 40% to 70%. Only one variety using the organic production system compared favourably to conventional production. MB: Pic 67:33 at 50 g/m^2 is the only formulation and rate registered for use in strawberry runners in PEI, and although this exceeds MBTOC's standard presumption of 20 g/m^2, the grower petitioned PMRA to use a lower rate under barrier films. PMRA, in the absence of a formal label amendment, granted permission to use a lower rate, but at the grower's own risk and liability. The CUN for 2017 is based entirely on a reduced rate for MB of 20 g/m^2 for the entire critical area (26.3 ha). **MBTOC assessment for MB use in this sector in 2018:** After thorough review of the information provided by the Party, MBTOC understands that the use of micro-propagated plants from USA and the scale up into soilless substrates is for the first stage of multiplication of runners at PEI to produce approximately 60,000 runners and that 420kg methyl bromide could be replaced or avoided if soilless is shown to be effective for this stage for which MBTOC believes there are effective alternatives. The nomination is presently requesting MB for this stage and the final two multiplication stages. Canada notes the first stage of this field production and multiplication is foundation stock. Whilst soilless production is technically feasible for the later stages of production (López-Galarza *et al.*, 2010, Rodríguez-Delfín; 2012; Miranda *et al*., 2014), MBTOC agrees from the information on economics that the use of soilless culture for the remaining runners may be uneconomical, but still considers this method could be feasible for part of the remaining nomination (Sjulin and Greene, 2014). For this reason, in previous years MBTOC agreed with the Party that the focus should be to find suitable alternatives for soil disinfestation and urged the Party to complete the groundwater studies to adopt chloropicrin either alone or in combination with other alternatives. Studies on potential groundwater contamination with Pic 100 commenced in December 2013 but were terminated as a result of a special review initiated by the Pest Management Regulatory Agency (PMRA) as stated in the last CUN. At the OEWG the Party has confirmed that no further groundwater studies will take place at PEI and chloropicrin cannot be considered as an alternative.

		MBTOC continues to find this situation difficult to understand given that the grower is allowed to apply Terr-O-Gas® (67:33) containing 33% chloropicrin. In other words, almost 2.6 tonnes of chloropicrin are used each year in mixes with MB. MBTOC also notes that metham sodium; metham potassium and dazomet are also registered in Canada and could be considered for use in PEI if studies were conducted and permits issued. The Party, however, indicated that the grower's ability to find alternatives to methyl bromide is currently limited because many of the feasible alternatives used in other jurisdictions are either not registered in Canada or prevented from use in PEI and, as such, they cannot be trialled. Additionally it is noted that the grower is proposing to undertake additional trials with strawberry grow bags to determine whether a successful protocol to grow plants of adequate quality and productivity is possible. **MBTOC comments on economics provided in CUN for 2018:** The economic information has not been updated in this year's nomination (see below). Canada's nomination is submitted mainly on the basis that there are no technically feasible alternatives or substitutes available to the growers that are acceptable from the standpoint of environment and health. **Comments requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b (i) Emission Reduction:** Yes, uses barrier films with a reduced application rate of MB conforming to MBTOC's presumptions. • **Dec. IX/6 b (iii) Research Program:** No evidence was provided to prove that a research program is in place. The proposed groundwater studies for pic were halted, and no new alternatives are currently tested. • **Dec. IX/6 b (iii) Appropriate Effort:** The Party has not demonstrated that it is engaged in an active research program. According to the nomination, the groundwater studies were suspended, as the PEI permit was not granted. The PEI Adapt Council funding has been discontinued with no new funding available since March 2014. No further work has been pursued with an expert previously contracted, as he has taken on a new role with less time available for research related to strawberry runner production.

[1]1ExMOP and 16MOP; [2]16MOP+2ExMOP+17MOP; [3]MOP17+MOP18; [4]MOP18+MOP19; [5]MOP19+MOP20; [6]MOP20+MOP21; [7]MOP21+MOP22; [8]MOP22, [9]MOP23, [10]MOP24, [11]MOP25, [12]MOP26, [12]MOP26**.** [13]MOP27

Table 1.10 Interim recommendations for CUNs from A5 Parties for preplant soil use submitted in 2017 for 2018.

Country	Industry	CUE for 2015[1]	CUE for 2016	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018						
Argentina	Strawberry Fruit	70	58	38.84	45.30	[29.00]						

MBTOC interim recommendation for 2018:

MBTOC recommends a reduced nomination of 29.00 tonnes for use in this sector in 2018. This includes 21.65 t for Lules (38.67 ha x 0.26) +(77.33 x 0.15) and 10.83 t for Mar del Plata. (19.33 ha x 0.26)+(38.67 x 0.15) .

The reduction is based on uptake of barrier films (e.g. TIF) for use with remaining MB treatments and a subsequent decrease in dosage rate from 26 to 15.0 g/m^2 for adoption of these films and a 10% reduction for the adoption of available alternatives applied using best practice (i.e. 1,3-D/Pic, rotations, improved application techniques for fumigants) over a transition period of three years. MBTOC considers barrier films are consistent with efforts to minimize emissions of MB and for this reason MBTOC has made a reduction of MB consistent with the second year of a 3 year transition.

MBTOC is concerned that the party in its CUN nominations has not provided data from any recent replicated trials in fields in Argentina. Of particular concern is that recent data showing the ineffectiveness of alternatives has not been provided and this lack of effort is inconsistent with the requirements of Decision IX/6. In the absence of such data, MBTOC, in making its recommendation, has relied on data from trials in similar sectors and situations worldwide (Lopez Aranda *et al*., 2016; further refs needed). MBTOC urges the Party to provide such data with future nominations. MBTOC reiterates that the effectiveness of alternatives may require a change in the present application methods and crop rotations used within these sectors. No further technical or economic evidence to show that soil injection methods for 1,3-D/Pic would not perform as effectively in the regions mentioned as compared to MB has been provided by the Party. MBTOC is also concerned that a regulation (Decree) is in place in the Mar del Plata region requiring the mandatory use of methyl bromide (70:30) and banning alternative fumigants, which goes against the intent of the Montreal Protocol. Additionally there is evidence that presently growers are using some chemical alternatives illegally. If this decree is to continue in place, MBTOC urges the party to focus research into non-chemical alternatives.

Nomination by the Party for 2018:

The Party nominated 45.3 tonnes of MB for critical uses for strawberry fruit production in field cultivation in the critical regions of Mar del Plata and Lules.

The nomination was based on a dosage rate of 26 g/m^2 of MB with standard polyethylene films (not barrier films). This included 30.20 t for Lules (200ha x 0.58 x 0.26) and 15.10 t for Mar del Plata (100 ha x 0.58 x 0.26). The key pests in Mar del Plata are fungi (*Phytophthora, Verticillium*), soil insects, nematodes and weeds (*Cyperus*). Key fungi in Lules are (*Phytophthora, Verticillium*, Anthracnose, *Rhizoctonia, Fusarium, Pythium, Macrophomina*). A MB:Pic 70:30 formulation is applied as a strip treatment (beds only) so only 58% of the area is effectively treated. The nomination bases the need for MB on the fact that alternatives, particularly 1,3-D/Pic, are not effective for high moisture soils in warmer regions or heavy clay soils (Lules) and that phytotoxicity occurs in the cold soil conditions of Mar del Plata. Missing a specific market windows is also of concern.

Circumstances of the nomination by the Party:

The Party states that 1,3-D/Pic does not control the entire pest spectrum attacking strawberries and has a longer plant back time or a phytotoxic effect, which leads to missed market windows. Metham sodium at the registered rate does not achieve yields comparable to MB treatments. According to the Party, low soil temperatures and heavy rainfall typically present at the time when fumigation needs to happen to ensure optimum yields and a timely harvest, challenge the adoption of alternatives. Chloropicrin alone is not registered and does not control weeds. Methyl iodide, which proved effective in trials, is no longer being considered for registration. Solarization and biofumigation are not considered practical in the critical areas and VIF and TIF are fairly new products that need to be imported.

According to the Party, results of trials conducted from 2001 to 2013 showed that 1,3-D/PIC, an alternative that is widely adopted in strawberry fruit crops worldwide, gave variable results in the Mar del Plata region, but good yields in the Lules region. Dazomet is not registered for edible crops. Metham sodium at a high rate of 0.25 l/m^2 with two drip tapes obtained similar yields as MB: Pic (70:30) at a rate of 40 g/m^2, but that rate is not registered. According to the Party, Pic is a technically and economically feasible

alternative to MB, but Pic alone is not registered in Argentina. DMDS is a promising alternative to MB, but it is also not available. Non-chemical alternatives, in particular solarisation, are widely used in the North, East and West of Argentina, but cannot be used in the central areas.

MBTOC assessment for MB use in this sector in 2018:

The Party stated that 1,3-D/Pic and other alternatives (i.e. metham sodium, metham potassium, metham ammonium) are ineffective under the particular circumstances of the nomination, however the nomination shows that higher yields can be obtained with 1,3-D/Pic in Lules. The Party shows economic information which assumes an 11 week delay in plant back times for 1,3-D/Pic, but this is inconsistent with results reported in other regions of the world where similar sub-tropical conditions prevail. MBTOC considers that 1, 3-D/Pic or Pic alone, which are the major chemical alternatives adopted worldwide, would be suitable for this sector, and has [considered uptake of shank applied 1,3-D/Pic] as part of the reduced recommendation.

MBTOC accepts that 1,3-D/Pic may be more difficult to use in cooler regions such as in some areas of Mar del Plata, and notes the issues with commercial scale up in this region of the nomination. The Party showed MBTOC the impact of high disease pressure caused by leasing land cropped recently with vegetables, particularly potatoes, which harbour strawberry pathogens (*Rhizoctonia* sp., *Verticillium* sp.) - MBTOC suggests that this practice should be avoided where possible to improve the performance of alternatives. The Party also indicated that most growers aim to get a two year crop from one application of MB/Pic, however yields can be 50% less in the second year. MBTOC suggests that annual treatment and adoption of better crop rotations may be a more suitable approach.

In previous assessments MBTOC has requested detailed scientific studies from the party to determine the effects of 1,3-D/Pic on the length of the plant back periods for strawberries in Lules (warm conditions) and Mar del Plata (cooler conditions), as compared to methyl bromide and in accordance with Decision IX/6. MBTOC again reiterates this request. In particular, further validation is required to support the longer plant back times for 1,3-D/Pic in the heavy rainfall region of Lules. MBTOC also noted that a high proportion of the present MB/Pic use is applied through drip irrigation lines used to irrigate strawberry crops, however MBTOC reiterates that shank application of MB/Pic formulations is considered a more effective application method. Shank injection of methyl bromide has been shown to improve the performance of both MB/Pic mixtures and that of alternatives, therefore providing better yields in the second year crop. MBTOC notes that research is underway in Argentina on non-chemical alternatives, such as biosolarisation and biofumigation with promising results (Gabriel, 2014).

MBTOC is also aware of references indicating positive results with other alternatives, such as metham ammonium, 1,3-D/Pic, metham sodium and metham potassium in the critical regions: Del Huerto, (2013) found no difference between the performance of MB and 1,3-D/Pic. Jaldo *et al*. (2007) showed that 1,3-D/Pic injected in the soil gave better yields that MB in Lules/Tucumán. Aldercreutz and Szczesny, (2008, 2010), showed that yields obtained in Mar del Plata with metham sodium and metham ammonium were comparable to those produced when fumigating with MB. Bórquez and Agüero (2007) found that weed control achieved with metham ammonium, metham sodium and metham potassium in Lules, was comparable to that obtained with MB 70:30 and that there were no significant differences in the total yields obtained with these treatments. Other studies confirmed these results (Bórquez and Mollinedo, 2009, 2010; Aldercreutz and Szczesny, 2008; Bórquez and Agüero, 2007). MBTOC is unclear why these results are not applicable to the regions nominated.

MBTOC acknowledges that alternatives are available for strawberry fruit, however this may require some improvements in application methods in order to be effective in Argentina. MBTOC encourages the Party to consider further adoption of Pic, 1,3-D/Pic, DMDS, metham sodium and Pic/DMDS to assist with phasing out this nomination.

MBTOC comments on economics provided in CUN for 2018:

The economic analysis provided by the Party shows that treatment with 1,3-D/Pic misses the market window and fetches lower revenues than MB.

For Mar del Plata

- The nomination assumes a yield reduction from 93 to 62 t/ha using 1.3-D + Pic because of heavy clay soils and low soil temperatures.
- From the yield reduction the nomination calculates a symmetrical gross revenue reduction as prices are assumed to be the same for the two treatments.

- The nomination argues that operating costs for the two treatments are similar, but this is not shown. It then argues that weed control costs of 1.3-D Pic would be greater than for methyl bromide, as will conversion to a one year production system. In this case yields are still assumed to be lower (15-20%) and the costs of fumigants, tarps and transplants will be higher. However, these costs are not given.

For Lules

- Provides data on the movement in prices from the early harvest to late harvest. Prices start at $6/kg and end at <$1.
- Argues that weed control is insufficient with 1.3-D Pic and that the planting time is short because of soil temperature and rainy conditions and prolonged plant back time. As a result, the strawberries miss the market window and are sold at the high-season price rather than the early-season price.
- In this case, yield is expected to increase with 1.3-D Pic, but despite this, the fall in prices results in a loss in revenue of around 50%.
- The "with methyl bromide" price is taken as $1.69/kg and the "with 1.3-D Pic" as $0.72
- Again, costs of production are expected to be similar for the two treatments, in this case without the caveats.

Comments requested in Dec. XX1/11 (para 9):

- **Dec. IX/6 b (i) Emission Reduction:** Barrier films are available but to date have not been adopted on a commercial scale.
- **Dec. IX/6 b (iii) MLF Assistance/Adoption of Effective Alternatives:** Trials and research have been conducted through the MLF projects implemented in Argentina and also directly by national institutions (e.g. INTA, EEAOC) and various universities.
- **Dec. IX/6 b(iii) Appropriate Effort:** MBTOC notes that considerable research has been conducted during the MLF funded projects and provided references. MBTOC is however unaware of present trials and results within the specific areas of the nominations.
- **Dec. Ex 1(4) Annex 1 National Management Strategies:** No detailed plan was provided, however the Party noted a few dot points of potentially suitable alternatives, including TIF mulching, resistant varieties and DMDS/Pic.

Country	Industry	CUE for 2015[1]	CUE for 2016	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018						
Argentina	Tomatoes	100	71.25	64.10	75.4	[47.7]						

MBTOC interim recommendation for 2018

MBTOC recommends a reduced amount of 47.7 t for use in this sector in 2018. This amount is based on a reduction for the second year, of dosage rates from 26.0 to 15.0 g/m^2 for adoption of barrier films (e.g. TIF) for a total of 54.1 t. This includes 10.8 t for Mar Del Plata (38.6 ha x 0.15)+(19.3ha x 0.26) and 43.3 t for La Plata (154.7 ha x0.15)+(77.3 ha x 0.26). MBTOC also reduced the nomination by a further 10% (6.41 t) to accommodate the uptake of other chemical and non chemical alternatives such as IPM (nematicides, biofumigation with chicken manure, steam and 1,3 D /Pic (Agrocelhone)). According to the Party, 1,3-D/Pic is currently used for 20-25 % of the tomato area.

Nomination by the Party for 2018

The Party nominated 75.4 tonnes of MB for critical uses for tomato production in protected cultivation in the critical regions of Mar del Plata (15.1 t, 58 ha) and La Plata (60.3 t, 232 ha), an amount higher than the approved amount for 2017 use. According to Decision Ex1/4, the Party should "*avoid any increase in methyl bromide consumption except for unforeseen circumstances".* Calculations were thus made on the basis of the 2017 final recommendation, which is 64.1 t. This includes 12.9 t for Mar Del Plata and 51.2 t for La Plata. The nomination does not contemplate use of VIF on the 33% of the tomato area, as per MBTOC's standard presumptions, accepted by the Parties.

The nominated area treated with MB was 290 ha. The broad acre area nominated was 500 ha, of which 58 % is fumigated at a dosage rate of 26 g/m^2 using standard LDPE

	films (i.e.), not VIF or TIF. TIF films can contribute to the sustainability of intensive crop agriculture not only by reducing fumigant emissions but also by making rate reduction possible. Growers in the State of California in particular, have benefited greatly from this barrier technology as the use of TIF provides significant relief from the harsh buffer zones which are otherwise required by the Californian Department of Pesticide Regulation when lower barrier films are used. From a product life-cycle point of view, TIF films can also be recycled (Chow and Scholten, 2016) Rootstocks and tomato cultivars resistant to *Nacobbus* are not yet commercially available, (Verimis *et al.*, 1997; Manzanilla-Lopez *et al*., 2002; Lax *et al*., 2016). However, MBTOC notes promising research results when grafting susceptible tomato varieties onto rootstocks with some resistance to this nematode (Mitideri *et al.,* 2013; Chale *et al.*, 2013; Ducasse *et al.*, 2013; Gutiérrez *et al.*, 2013, 2014; Andreau *et al.*, 2014) and to *Meloidogyne* (Lobos *et al.*, 2013). The nominated regions have the potential of producing *Nacobbus* resistant plants when available. Grafting vegetables robots, particularly for tomatoes and cucurbits have been developed to increase productivity and rooting success rate while reducing costs. These robots are currently used in many countries (Kubota *et al.,* 2008, Lee *et al.,* 2010, Ashraf *et al.,* 2011, Coba *et al.,* 2016) Successful research on combined alternatives (biofumigation, solarisation) has also been conducted and promising results have been obtained (Garbi *et al.*, 2013; Mezquíriz *et al.*, 2013; Martínez *et al.*, 2014; Quiroga *et al.*, 2014). These technologies will require time for scale-up, however MBTOC anticipates that it is possible to implement these and other alternatives to fully replace MB in the near future. Argentina is also encouraged to consider registration of herbicides for controlling nutsedge [Herbicides], which are used in other countries as part of integrated control schemes. The target pests are nematodes (*Nacobbus* spp. and *Meloidogyne* spp.), fungi (*Rhizoctonia* sp., *Sclerotinia* spp., *Phytophthora* spp.), soil fungi disease complex (damping off) in seedbeds and crops, weeds (*Cynodon* spp., *Cyperus* spp., etc.) and soil insects (*Agrotis* sp., *Agriotes* sp., *Melolontha* sp.). MB is used in regions where cold and heavy clay soil conditions prevail, representing 31.25% of the total protected tomato production area. However, despite of the new information provided by the Party in response to MBTOC's questions, MBTOC is still concerned with the temperature information provided and urges the Party to provide further clarification of soil and ambient temperatures inside and outside green houses in any future nominations. **Circumstances of the nomination by the Party** The Party stated that 1,3-D/Pic did not provide sufficient control of key pests in the critical areas, mainly due to soil types, which were heavy clay soils and to soil temperatures (5 to 23° C). Chloropicrin alone did not control the entire pest complex including weeds and is not registered as a single product in Argentina. Metham sodium gave erratic and insufficient performance for weed and disease control, because the heavy clay soils inhibited movement of this fumigant throughout the soil. Dazomet is not registered for edible crops, plus trials with this fumigant showed insufficient nematode control. Long-term efficacy was not enough for the dual cropping system (tomato and pepper). Steam was very costly and time consuming. Application with currently available equipment was extremely slow and size of equipment was too big for use inside greenhouses. Grafting is a fairly new technology for Argentina, with some commercial and native rootstocks presently under study. Although potential production of grafted plants is high, no resistant rootstocks to *Nacobbus* are presently commercially available. According to the Party, cold climate, heavy soil conditions and overlapping key production period make solarisation and biofumigation unsuitable for the regions of La Plata and Mar del Plata. **MBTOC assessment for MB use in this sector in 2018:** The Party provided sufficient information on the historic cropping areas (except for 2015 and 2016), MB usage, specific definition of the critical area, and reasons why alternatives to methyl bromide were not technically and economically feasible. Using the information provided in the nomination, MBTOC recommends 47.7 t of MB. Grafting tomatoes onto resistant rootstocks to various pathogens (*Fusarium, Verticillium, Meloidogyne* spp.) is an effective disease control method presently in use in many A5 countries such as China, Egypt, Lebanon, Mexico, Morocco, Romania, Tunisia and Turkey (MBTOC, 2011; 2015), but rootstocks resistant to *Nacobbus* have not yet been identified (Veremis *et al*., 1997). However, encouraging results have recently been obtained (Mitideri *et al.,* 2005; 2013, Garbi *et al,* 2013). The Party reported that grafted plants are produced and commercially available in various tomato-growing regions such as Mendoza, Corrientes and Buenos Aires. Use of resistant cultivars is also a very effective strategy used to increase yield and manage soilborne diseases and nematodes, except *Nacobbus*, in vegetables around the world (Devran and Sogut, 2010; Christos *et al*., 2011; Fery *et al* , 2011; Jari *et al*., 2011). No resistant tomato variety to the false nematode is currently available (Lax *et al.,* 2011, Lax *et al* 2016, Sisler and Casaurang, 1983).

	1,3-D/Pic is a key alternative to MB, which is widely accepted commercially for controlling soil nematodes and fungi and has consistently shown to be as effective as MB (Minuto *et al*., 2006; Porter *et al*., 2006, Ji *et al.*, 2013). However, according to the party, 1,3 D + Chloropicrin did not show stability under Argentinean CUN conditions. Chloropicrin does not control the entire soil borne pathogens complex, including nematodes and weeds. This fumigant is not registered as a single product in Argentina. Metham sodium gives erratic and insufficient performance for control of weeds and soilborne pathogens. Dazomet is not registered for edible crops and does not control nematodes. Steam is not available and is considered to be costly. Fluensulfone (Nimitz®) is a contact nematicide with low human and environmental restrictions that targets nematodes including *Nacobbus.* Hidalgo *et al.,* (2015) reported a significant reduction in population density, reproduction rate, and root galling of *N. aberrans* after fluensulfone applications on tomato*.* The reduction was similar to that obtained with 1,3 D/Pic. They concluded that fluensulfone use in tomato and cucumber crops affected by *N. aberrans* could be considered as a good alternative to methyl bromide and other non-fumigant nematicides. Fluensulfone has also been identified as one of the main alternatives to MB for nematode control on many crops (berries, cucurbit, leafy and fruiting vegetables. Pic-Clor 60 combined with fluensulfone showed lower galling index as compared to Pic-Clor 60 alone (Castillo et al 2016) MBTOC notes that the Party has been supported by the MLF with a number of demonstrations, investment and technical assistance projects since 1997 and that many alternatives have been trialed and found successful in this sector (MLF, 2014 a, b). An Integrated program has been developed by Cristobal-Alejo *et al* (2006) in Mexico, including fertilization,nematicide application (ethoprop) and biofumigation with chicken manure. It resulted in significant increases of plant height, foliage dry weight, stem diameter and crop yield, as compared to other treatments. *Nacobbus* is widely distributed in North and South America. It has been reported in Mexico, USA (California, Colorado, Nebraska, Utah, Wyoming)., Bolivia, Chile, Ecuador and Peru. All these countries are producing Tomato without MB (EPPO 2009, Stone and Burrows, 1985) . In Mexico, *N.aberrans* attacking greenhouse peppers is controlled with various chemical and non-chemical control methods (Pérez-Rodríguez *et al* 2010). **MBTOC comments on economics provided in CUN for 2018:** • Assumes a substantial yield reduction in both cases while prices and costs remain the same for both treatments for both crops. • Revenue reduction of 28% results. • The reduction in revenue is partly due to a smaller drop in yield on the early crop but mostly due to the impossibility of a late crop because of the waiting time between applications and planting. **Comments requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b (i) Emission Reduction:** Barrier films are available. • **Dec. IX/6 b (iii) MLF Assistance/Adoption of Effective Alternatives:** Trials and research have been conducted through the MLF projects implemented in Argentina and also directly by national institutions (e.g. INTA, EEAOC) and various universities. • **Dec. IX/6 b (iii) Appropriate Effort:** MBTOC recognizes that considerable research and commercial trials have been conducted. • **Dec. Ex 1(4) Annex 1 National Management Strategies:** MBTOC notes that Argentina provided a summary strategy showing key steps anticipated to phase out MB in 2019.

Country	Industry	CUE for 2015[1]	CUE for 2016	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018						
China	Ginger Open field	90	90	74.617	74.617	68.88						

MBTOC Interim Recommendation for 2018:

MBTOC recommends a reduced amount of 68.88 t of MB for this use in 2018. MBTOC has calculated the nomination based on the adoption of barrier films on the total nominated area at the rate of 30 g/m^2 (229.59 ha x 30 g/m^2= 68.88 t).

Barrier films (TIF and VIF) are produced in China are expected to be used on 114 ha (50%,of the fumigated area) at a rate of 30g/m^2, according to MBTOC's standard presumptions for sandy and heavy soils and to meet the requirements of Decision IX/6 to minimize emissions. DMDS is also a promising alternative, but is awaiting registration.

In addition, MBTOC notes that the party considers the adoption of Bordeaux mixture ($Cu(OH)_2 + CaSO_4$) as an alternative now registered in China warrants further investigation; MBTOC further suggests improved hygiene for planting stock is essential. No further reduction for uptake of alternatives has been made as MBTOC acknowledges the parties' intention to phase out MB in 2019.

Nomination by the Party for 2018:

China nominated 74.617 tonnes of MB as a critical use for 2018, for open field ginger production on an area of 229.59 ha at a rate of 350 kg/ha on 50% of the nominated areas and 300 kg/ha on the remaining 50% of the nominated areas (229.59 ha x 0.5 x 35 g/m^2= 40.178t) and with VIF (229.59 ha x 0.5 x 30 g/m^2 = 34.439 t).
The target pests are *Ralstonia solanacearum*, *Pythium* spp., *Meloidogyne* spp. and *Cyperus rotundus*. MB is used in regions where soil-borne pathogen pressure is high and this only represents a small percentage (0.30%) of the total ginger cropping area. The request is only for ginger grown in the Shandong region where this crop is grown continuously and where pest pressure is high.

Circumstances of the nomination by the Party:

China submitted a National Management Strategy to completely phase out MB in 2019. The Chinese government is encouraging research and development of new MB alternatives, speeding the registration process for chemicals to completely phase out MB by 2019. China is using small disposable canisters of MB (681 g/canister), with standard polyethylene films. MB canisters (98:2) are applied as cold gas at a rate of 35g/m^2, which is below the rate registered in China. According to the Party, chloropicrin is the only chemical alternative registered in China for this sector but did not provide effective control of *Meloidogyne* spp and *Cyperus rotundus*. In addition, chloropicrin causes phytotoxicity and requires longer fumigation times, forcing farmers to postpone the planting time and affecting yield, quality and market windows. A recent study however confirms that chloropicrin is a promising alternative with good efficacy against *Ralstonia solanacearum*, which can be used successfully in integrated pest management programs in China (Mao *et al.,* 2014).

In spite of their proven efficacy, other chemical alternatives, 1,3-dichloropropene, dazomet, iodomethane, metham sodium, dimethyl disulfide and sulfuryl fluoride are not registered for ginger in China. SF has been shown to control root-knot nematodes and to reduce the levels of key soil pathogens in research trials (Cao *et al.,* 2014). Chloropicrin has been formulated in capsules for trial work (Wang *et al.,* 2013), which have yielded encouraging results (Mao *et al.,* 2014). The 1,3-D/Pic capsule formulation tested provides a promising soil pest and disease control method, which at the same time reduces environmental emissions and potential human exposure in greenhouse vegetable production (Wang *et al.,* 2013). Telone C-35 is an excellent MB alternative providing acceptable weed control efficacy (Ji *et al.,* 2013, *Qiao et al.,* 2012), but this formulation is not registered. Results of the experiment on Pic + 1,3-D conducted in 2015 and reported in the 2016 CUN shows that the marketable yield obtained with TeloneC35 is lower than the yield obtained with MB, chloropicrin and dazomet. The party reported that Bordeaux mixture has been newly registered on ginger. These chemicals alone or in combination, could control efficiently fungal, bacterial and nematodes diseases of ginger (Yang *et al.,* 2011ab, Mao *et al.,* 2014, Huang *et al*., 2016). DMDS is expected to be registered in 2018. Pendimethalin has been tested as herbicide as alternative to MB (Huang *et al.*, 2016).

According to the Party, non-chemical alternatives (crop rotation, bio-fumigation, solarisation, steaming, soilless culture) are not technically and economically feasible when used alone but may be useful in an IPM program. Preliminary results obtained when using soilless cultures have shown that the marketable yields obtained are lower that the yields obtained with MB. Liangang *et al.* (2016) reported that flame soil disinfestation (FSD) is a novel, promising non-chemical method to control soilborne nematodes, fungal and bacterial pathogens (*Meloidogyne incognita*, *Fusarium oxysporum*, *Phytophthora* spp and and *Ralstonia solanacearum*) in China.

MBTOC assessment for MB use in this sector in 2018:

The Party states that alternatives are not available for this nomination, particularly 1,3-D/Pic, which is not registered in China. MBTOC notes that other countries, which in the past applied MB canisters on a small-scale basis have phased out for this sector (e.g. Japan). The amount requested in the nomination is based on a dosage rate of 35g/m^2 (without VIF or TIF) applied with MB canisters.

MBTOC considers that in the absence of effective alternatives, MB/Pic 50:50 can be suitable for this sector, but China would need to develop technology to formulate and apply this formulation. MBTOC considers that barrier films are available and should be used on the total nominated area. MBTOC is also aware that Pic combined with DMDS or Pic +fosthiazate have shown promising results in China (Cao, pers. comm.). The Ministry of Environmental Protection (MEP) has funded nine companies to register and develop MB alternatives and one company to carry out the commercial demonstration of anaerobic soil disinfection technology. MBTOC expects that the results obtained will be rapidly made available for adoption.

MBTOC notes that since 1994 the Party has been supported by the MLF with one demonstration project, three project preparation grants and one investment project comprising eight tranches and that many alternatives have been tried. Funding from the MLF committed the Party to phase out its whole MB consumption for controlled uses by the end of 2014 (MLF, 2014 ab). According to reports presented to the ExCom, satisfactory pest and disease control has been obtained in ginger crops with the combination of chloropicrin, improved application methods of this fumigant and dazomet, other chemicals and biological nematicides, in an IPM approach. Pic is used for soil fumigation in areas where the main ginger soil-borne pathogens *Pythium* spp. and *Ralstonia solanacerum* are the main pathogens.

MB canisters are used because they provide small-scale farmers with an easy application method and the ability to apply targeted amounts of MB to small areas where injection machinery may be difficult to use (TEAP, 2008). However, MB canisters have been banned for soil use in many Article 5 countries, as this application is considered less efficient than injection methods and more dangerous to workers since trained contractors are not required for their application. This practice also leads to high emissions of MB. In some situations, MB gas has been found to leak during storage because of poor air tightness of canisters.

MBTOC comments on economics provided in CUN for 2018:

The price of ginger is lower with chloropicrin (MB: $1.31/kg, Pic: $0.65/kg) because of the impact of root-knot nematodes on quality. Yield with MB is 96.45 t/ha, while with Pic is 86.22 t/ha, again because of the effect of root-knot nematodes.
Gross revenue with Pic is 44% of that of MB (because of the yield and price difference). Net revenue is 25% of that of methyl bromide

Comments requested in Dec. XX1/11 (para 9):

- **Dec. IX/6 b (i) Emission Reduction:** VIF and TIF are produced but not used for this use in China.
- **Dec. IX/6 b (iii) MLF Assistance/Adoption of Effective Alternatives:** Research trials within the MLF-funded investment project commenced in this sector in 2008 Progressive results of the experiments which Ministry of Environmental Protection (MEP) has funded are expected to be available and adopted. Results are also expected from the nine companies responsible of registering and developing MB alternatives and from the company carrying out the commercial demonstration of anaerobic soil disinfection technology
- **Dec. IX/6 b (iii) Appropriate Effort:** Yes, considered appropriate as experiments are being conducted to phase out MB by 2019. and to register new fumigants
- **Dec. Ex 1(4) Annex 1 National Management Strategy:** China provided a summary strategy showing plans to phase the Critical-Use Exemption of Methyl Bromide on ginger in 2019.

Country	Industry	CUE for 2015[1]	CUE for 2016	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018						
China	Ginger Protected	24	21	18.360	18.360	18.360						

MBTOC Interim Recommendation for 2018:

MBTOC recommends a the full amount of 18.360 t of MB for this use in 2018 (61.2 ha x 30g/m^2=18.360 t) based on 100% adoption of barrier films, which MBTOC considers are suitable for the nomination and meet the requirements of Decision IX/6 to minimize emissions. Barrier films (VIF and TIF) are produced in China and are expected to be used on 61.2ha (100%,of the fumigated area) at a rate of 30g/m^2, according to MBTOC's standard presumptions for sandy and heavy soils and to meet the requirements of Decision IX/6 to minimize emissions..

In addition, MBTOC urges the party to consider the adoption of alternatives, such as $Ca(OH)_2$ + $CuSO_4$ and to implement improved hygiene for planting stock which have been registered in China. No reduction for uptake of alternatives has been made as MBTOC acknowledges the parties' intention to phase out MB in 2019.

Nomination by the Party for 2018:

China nominated 18.360 t of MB as a critical use for protected ginger production on 61.2 ha at a rate of 30 g/m^2 for use in 2018. The target pests are *Ralstonia solanacearum*, *Pythium* spp., *Meloidogyne* spp. and *Cyperus rotundus*. MB is used in regions where soilborne pathogen pressure is high and this only represents a small percentage of the total ginger cropping area 12.24%). The request is only for ginger grown in the Shandong region where this crop is grown continuously and where pressure from the target pests is high.

Circumstances of the nomination by the Party:

In 2016, China submitted a National Management Strategy to completely phase out MB in 2019. The Chinese government is supporting research and development of new MB alternatives and speeding up the registration process for chemical to completely phase out MB by 2019.

China is using small disposable canisters of MB/Pic (681 g/canister), using VIF films. MB/Pic is applied in canisters (98:2), as cold gas at a rate of 35 g/m^2. According to the party, Chloropicrin, dazomet, Bordeaux mixture ($Cu(OH)_2$ + $CaSO_4$) have been registered in 2016 . Pic alone did not provide effective control of *Meloidogyne* spp.and *Cyperus rotundus*. In addition, Pic causes phytotoxicity and requires a longer fumigation time than MB, forcing farmers to postpone the planting time and affecting yield, quality and marketing. A recent study however confirms that Pic is a promising alternative with similar effectiveness to MB against *Ralstonia solanacearum*, which can be used successfully in integrated pest management programmes in China (Mao *et al.,* 2014).

In spite of their proven efficacy, other chemical alternatives such as 1,3-dichloropropene, iodomethane, metham sodium and dimethyl disulfide are not registered for use in ginger in China. In research trials, SF has been shown to control root-knot nematodes and reduce the levels of key soil pathogens (Cao *et al.,* 2014). Pic and 1,3-D have been formulated in capsules for trial work and results are encouraging (Mao *et al.,* 2014). The 1,3-D/Pic capsule formulation provides a promising method for soil pest and disease control, reducing both environmental emissions and potential human exposure in greenhouse vegetable cultivation (Wang *et al*., 2013). Telone C35 is an excellent MB alternative and has provided acceptable weed control efficacy (Ji *et al.,* 2013, Qiao *et al.,* 2012), but this formulation is not registered. Results of the experiment on Pic + 1,3-D conducted in 2015 and reported in 2016 CUN show that the marketable yield obtained with Telone C35 is lower that the yield obtained with MB. Chloropicrin, dazomet, metham sodium, Bordeaux mixture are now registered on ginger. These chemicals alone or combined could control efficiently fungal, bacterial and nematodes diseases of ginger (Yang *et al*., 2011ab, Mao *et al*., 2014, Huang *et al*., 2016). DMDS is expected to be registered in 2018. Pendimetyhalin has been tested as herbicide as alternative to MB (Huang *et al.,* 2016).

	According to the Party, non-chemical alternatives (crop rotation, bio-fumigation, solarisation, steaming, soil less) are not technically and economically feasible when used alone but may be useful as part of an IPM program. Preliminary results obtained when using soilless cultures have shown that the marketable yields obtained are lower that the yields obtained with MB. Liangang *et al*., (2016) reported that flame soil disinfestation (FSD) is a novel, promising non-chemical method to control soilborne nematodes, fungal and bacterial pathogens (*Meloidogyne incognita Fusarium oxysporum , Phytophthora* spp and *Ralstonia solanacearum*) in China. **MBTOC assessment for MB use in this sector in 2018:** The Party states that alternatives are not available for this nomination, particularly 1,3-D/Pic, which is not registered in China. MBTOC notes that other countries, which in the past applied MB canisters on a small-scale basis have phased out for this sector (e.g. Japan). The amount requested in the nomination is based on a dosage rate of 35g/m^2 (without VIF or TIF) applied with MB canisters. MBTOC considers that in the absence of effective alternatives, MB/Pic 50:50 can be suitable for this sector, but China would need to develop technology to formulate and apply this formulation. MBTOC considers that barrier films are available and should be used on the total nominated area. MBTOC is also aware that Pic combined with DMDS or Pic +fosthiazate have shown promising results in China (Cao, pers. comm.). The Ministry of Environmental Protection (MEP) has funded nine companies to register and develop MB alternatives and one company to carry out the commercial demonstration of anaerobic disinfection technology. MBTOC expects that the results obtained will be rapidly made available for adoption. MBTOC notes that since 1994 the Party has been supported by the MLF with one demonstration project, three project preparation grants and one investment project comprising eight tranches and that many alternatives have been tried. Funding from the MLF committed the Party to phase out its whole MB consumption for controlled uses by the end of 2014 (MLF, 2014 ab). According to reports presented to the ExCom, satisfactory pest and disease control has been obtained in ginger crops with the combination of chloropicrin, improved application methods of this fumigant and dazomet, other chemicals and biological nematicides, in an IPM approach. Pic is used for soil fumigation in areas where the main ginger soil-borne pathogens *Pythium spp*. and *Ralstonia solanacerum* are main pests. MB canisters are used because they provide small-scale farmers with an easy application method and the ability to apply targeted amounts of MB to small areas where injection machinery may be difficult to use (TEAP, 2008). However, MB canisters have been banned for soil use in many Article 5 countries, as this application is considered less efficient than injection methods and more dangerous to workers since trained contractors are not required for their application. This practice also leads to high emissions of MB. In some situations, MB gas has been found to leak during storage because of poor air tightness of canisters. **MBTOC comments on economics provided in CUN for 2018:** The price of ginger is lower with chloropicrin (MB: $1.31/kg, Pic: $0.65/kg) because of quality impact of root-knot nematodes. Yield with MB is 96.45 t/ha, while with Pic it is 86.22 t/ha, again because of the effect of root-knot nematodes. Gross revenue with Pic is 44% of that of MB (because of the yield and price difference). Net revenue is 25% of that of methyl bromide. **Comments requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b (i) Emission Reduction:** VIF and TIF are produced but not used for this use in China. • **Dec. IX/6 b (iii) MLF Assistance/Adoption of Effective Alternatives:** Research trials within the MLF-funded investment project commenced in this sector in 2008 Progressive results of the experiments which Ministry of Environmental Protection (MEP) has funded are expected to be available and adopted. Results are also expected from the nine companies responsible of registering and developing MB alternatives and from the company carrying out the commercial demonstration of anaerobic soil disinfection technology • **Dec. IX/6 b (iii) Appropriate Effort:** Yes, considered appropriate as experiments are being conducted to phase out MB by 2019 and to register new fumigants • **Dec. Ex 1(4) Annex 1 National Management Strategy:** China provided a summary strategy showing plans to phase the Critical-Use Exemption of Methyl Bromide on ginger in 2019.

[1]1ExMOP and 16MOP; [2]16MOP+2ExMOP+17MOP; [3]MOP17+MOP18; [4]MOP18+MOP19; [5]MOP19+MOP20; [6]MOP20+MOP21; [7]MOP21+MOP22; [8]MOP22, [9]MOP23, [10]MOP24, [11]MOP25,[12]MOP26**.** [13]MOP27

1.5. Interim Evaluation of Critical Use Nominations of Methyl Bromide for Commodities and Structures in 2018

1.5.1 Standard rate presumptions

MBTOC assessed the SC CUNs from one Party, South Africa, which consisted of a request for two sectors in one nomination. These two sectors were disaggregated by MBTOC with agreement from the nominating party and assessed separately for appropriate MB dosage rates and deployment of MB emission/use reduction technologies, such as appropriate sealing techniques.

Decision IX/6 requires that critical uses should be permitted only if '*all technically and economically feasible steps have been taken to minimise the critical use and any associated emission of methyl bromide*'. Decision Ex.II/1 also mentions emission minimisation techniques, requesting Parties "…*to ensure, wherever methyl bromide is authorised for critical-use exemptions, the use of emission minimisation techniques that improve gas tightness or the use equipment that captures, destroys and/or reuses the methyl bromide and other techniques that promote environmental protection, whenever technically and economically feasible.*"

At the beginning of the CUN process in 2005, MBTOC published its standard presumptions for structures (20g m^{-3}) and indicated that the European Plant Protection Organization's (EPPO) published dosage rates for commodities should be considered standard best practice for fumigation worldwide. Since that time all Parties submitting CUNs stated their adherence to those practices. The EPPO dosage rates for commodity treatment vary by commodity, sorption rate and environmental conditions. They can be found in annexes to the MBTOC 2006 Assessment Report (MBTOC, 2007). Where possible, reduced dosages, combined with longer exposure periods, can reduce MB consumption, while maintaining efficacy (MBTOC 2007, 2011, 2017).

1.5.2. Details of the evaluation

The total MB volume nominated in 2017 for post-harvest uses in 2018 was 50 tonnes. MBTOC recommended 45.65 tonnes for South Africa for 2018 (Table 1.11). Table 1-12 provides MBTOC-SC final recommendation for the CUN submitted.

Table 1.11. Summary of the final recommendations for a CUE for postharvest uses of MB (tonnes) for 2018 submitted in the 2017 round.

Country and Sector	Nomination for 2018 (tonnes)	Interim Recommendation for 2018 (tonnes)
South Africa - Mills	5.0	2.9
South Africa - Structures	45.0	42.75
Total	**50.0**	**45. 65**

Table 1.12. Interim Recommendations for CUNs from A5 Parties for structures and commodities submitted in 2017 for 2018.

Country	Industry	CUE for 2015[11]	CUN for 2016	CUE for 2016	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018			
South Africa	Mills	--	13.0	5.462	4.1	**5.0**	**[2.9]**			

MBTOC interim recommendation for 2018:

MBTOC recommends a reduced amount of 2.9 tonnes for 2018, for pest control by fumigation in specific mills/food processing facilities. This recommendation represents a reduction of 29% from the CUE of 2017. It is based on an amount of MB sufficient for one fumigation per year and per mill as a transitional measure to allow time for adoption and optimisation of alternatives in an IPM system. The recommendation is based on a dosage of 20 g/m³ (MBTOC standard presumption) applied to well-sealed structures. MBTOC analysis is based on the circumstances recognised in the CUE of 2017 of 4.1 tonnes not the CUN quantity of 5.0 tonnes, following Decision Ex 1/4.

Nomination by the Party for 2017:

This nomination forms part of the initial CUN for [50] tonnes covering both fumigation of specific flour and grit mills against stored product insect pests (5 t) and domestic and industrial premises for control of wood destroying insect pests (45 t). Being distinct uses with specific issues each, MBTOC, with acceptance by the nominating Party, has disaggregated this nomination into two separate CUNs.

Circumstances of the nomination:

The Party nominated 5 tonnes of MB for the fumigation of 8 grain mills, total capacity of 148,540 m³, for pest control against common stored product insect pests. Individual mills are currently treated at least once a year at about 25 g/m^3. This is a reduction from the 48 g/m^3 used by the party in the past. Use of methyl bromide fumigation on a calendar basis, and not according to prevalence of pests, is a routine part of pest control in the specific mills. This is to ensure output of uninfested product from the mills and to comply with certification accreditation.

Grain mills in South Africa have to comply with stringent requirements for hygiene to attain insect and pest free conditions during production and storage. These relate to both local and international insect control and quality assurance standards. Full site treatments with heat, sulfuryl fluoride or phosphine were considered as alternatives by the Party, but were found not currently feasible. Sulfuryl fluoride is not currently registered, though registration is under consideration. Phosphine fumigation was considered inappropriate because of cost of downtime, the associated corrosion and risk of damage to sensitive electrical and electronic apparatus in mill machinery. Heat treatment was considered not feasible because of the capital cost of imported equipment needed to carry out the heating.

MBTOC assessment for MB use in this sector in 2018:

MBTOC considers that various suitable alternatives are available or feasible for the necessary disinfestation of all mills in this CUN (Bell and Savvidou, 1999; Bell *et al.,* 2003; Drinkall *et al.,* 1996; Drinkall *et al.,* 2003; Ducom *et al.,* 2003; MBTOC Assessment reports 1998, 2002, 2006, 2010, 2014; Reichmuth *et al.,* 2003). Whole site fumigation of flourmills with methyl bromide has been discontinued in other countries. Where whole site treatment is still practiced, periodic applications have been carried out with heat or various other fumigants (sulfuryl fluoride, hydrogen cyanide, phosphine). Some mills have never been fumigated with methyl bromide as whole site fumigations. Alternative targeted approaches provide adequate insect infestation control. Effective pest control in mills in general requires a combination of measures applied rationally including, as circumstances and registration permit, localised and full-site heat treatment, fumigation with hydrogen cyanide, phosphine or

	sulfuryl fluoride, as possible according to local registration and circumstances, and various diverse insect control measures applied as an IPM system. Pest control intervention may be guided by appropriate pest monitoring (Belda *et al.*, 2011; *Campbell et al.*, 2004; Trematerra *et al.,* 2007). Change from an established system of periodic routine methyl bromide treatment requires some time to trial, refine and implement, hence the continued partial MBTOC recommendation for the nominated CUE, despite the general availability of alternatives for this situation. Subsequent to the previous CUN, the mills have been treated at reduced dosages and frequencies (25 g m^3 1x per year) with satisfactory results. Modifications to the mill structure and machinery may be needed to remove pest harbourage as part of the IPM system. Some changes have already been implemented in 2016 and 2017. IPM measures, cleaning and sanitation, as well as spraying of insecticides, and localised heat treatment of infested machinery in larger mills, should lead to a reduced requirement for, or elimination of, full site fumigations. Improved inspection of imported grain is essential; if insects are intercepted separate phosphine fumigation should be conducted, in sufficiently gas tight silo bins prior to introducing this grain into the mills and the milling process. This recommendation is based on MB sufficient for one fumigation per year per mill as a transitional measure to allow timely optimisation of alternatives. The recommendation is based on a dosage of 20 g/m^3 (MBTOC standard presumptions) applied to well-sealed structures. MBTOC anticipates that the frequency of whole site treatments can be further reduced, or even eliminated, by well planned specific IPM programs for each mill. The Party may wish to instruct users to reduce the whole site fumigation frequency this year (2018) to once every two years (or still less frequently) to gain experience in effective use of alternative integrated systems, as practiced in many other countries (Bell, 2014). MBTOC urges that an implementation program is continued or put in place immediately in each mill to address alternatives, and results supplied to MBTOC as required under Decision IX/6 (1,b,ii). Although the regulated quarantine pests, Khapra beetle, *Trogoderma granarium* and Larger Grain Borer *Prostephanus truncatus,* were listed in the CUN, in subsequent correspondence the Party clarified that the mill treatments are not routinely used against these pests. MBTOC information suggest heat treatments may be similar in running cost to existing MB use and have moderate capital requirements, significantly less than indicated in correspondence about this CUN. **MBTOC comments on economics provided in CUN for 2018:** The party is aware that the price of MB is increasing over time whilst the cost of heat treatment is coming down. **Comments requested in Dec. XX1/11 (para 9)** • **Dec. IX/6 b (i) Emission Reduction:** The CUN states that a high level of fumigant containment has been achieved. • **Dec. IX/6 b (iii) Research Program:** There are ongoing efforts to obtain registration for two fumigants, ethyl formate and sulfuryl fluoride, in the near future. These may be useful as replacements in part or completely for methyl bromide.**Dec. IX/6 b (iii) Appropriate Effort:** see previous paragraph. • **Dec. Ex 1(4) Annex 1 National Management Strategy:** No Management Strategy was provided.

Country	Industry	CUE for 2015[11]	CUN for 2016	CUE for 2016	CUE for 2017	CUN for 2018	MBTOC interim recommendation for 2018			
South Africa	**Houses**	**--**	**68.6**	**68.6**	**55.0**	**45.0**	[42.75]			

MBTOC interim recommendation for 2018:

MBTOC recommends a reduced amount of 42.75 tonnes for houses/structures in 2018, which represents a 5% reduction of the amount requested by the Party and a reduction of 37.7 % of the approved amount in 2016 (68.6 tonnes) for this sector.

Nomination by the Party for 2018:

This nomination forms part of the initial CUN for 50 tonnes covering both fumigation of specific flour and grit mills against stored product insect pests (5 t) and domestic and industrial premises for control of wood destroying insect pests (45 t).

Circumstances of the nomination:

The Party applied for 45 t of MB for disinfestations treatment against wood destroying pests. These insects were found attacking wooden components in various structures, mainly houses and residential units (2,560 facilities and houses, mainly brick, mortar and iron structures) along coastal areas and partly inland with a typical volume of 600 m³ to 850 m³ and some much larger buildings. About 75% are complete structure fumigations for about 1,152,000 m³ and 25% partial fumigations (individual rooms, individual flats, calculated with about 1/5 of a 600 m³-structure) for 384,000 m³ leading to 41.47 tonnes plus 3.53 tonnes, resulting in a total of 45 tonnes used. About 200 structures are fumigated per month. Five target pests in the described situation are presented in the nomination – *Cryptotermes brevis*, the West Indian drywood termite; *Hylotrupes bajalus*, the European house borer, and the small wood and furniture beetles, *Anobium punctatum*, *Lyctus brunneus* and *Nicobium castaneum*.

The number of tonnes of MB is not specifically contributed to some fumigations for control of *Lyctus brunneus* and *Hylotrupes bajulus*, requiring higher dosages and possibly smaller parts of treated structures.

The treatments are carried out either on whole houses under PVC 450 µm tarpaulin or on gas tight sealed parts of structures. The Party stated that attics are never fumigated separately in RSA.

Application of heat, a technique used under similar circumstances in many countries was regarded by the Party as not feasible due to very high investment needed for heating units from abroad and excessive running costs compared with costs for MB treatment and lack of access of the heat into some parts of the roof spaces. Heat treatment for control of wood boring pests would not be acceptable in the case of selling a house and obtaining a “Free of Insects Certificate”. Sale agreements and legal requirements for houses along the East coast of RSA stipulate that the structure be apparently free of “timber destroying insects” and that should such insects be found then the structure must be made apparently insect free. A Certificate of Clearance is required for a sale to proceed and this can only be produced once an inspection has been undertaken and treatment if the wood is found to be infested. Treatments are not undertaken if wood destroying insects are not detected.
The applicant states that the application of MB combined with additional gas such as carbon dioxide will be investigated to determine the effectiveness and economic feasibility of such application.

	The label for MB use for this sector to achieve control of the mentioned insect species states that an initial dosage of 48 g/m³ at temperatures above 15°C must be applied with exposure period of 24 h. The Party states that the registration process for sulfuryl fluoride, a potential fumigant alternative in use in many other parts of the world for this application, is again intensively pursued. The official release of the registration would still be followed by about two years of preparation of the fumigating companies to enter into the practice of fumigation. The Party notes that termite control may be difficult with SF due to risk of not controlling the most tolerant developmental stage, the eggs. MBTOC notes, however, that for controlling termites the ensured killing of the queens could be sufficient and can be achieved with SF with fairly low ct-products in the range of 500 gh/m³ (20 g/m³ for 25 h) and exposure under sheeted and well-sealed houses. These conditions are commonly known to control drywood termites (Stewart, 1957, Osbrink *et al.,* 1987). Fumigation with hydrogen cyanide (Rambeau *et al*., 2001) and even inert atmospheres, like nitrogen and carbon dioxide with low residual content of oxygen are effectively used under corresponding conditions (Lewis and Haverty, 1996, Reichmuth, 2007). **MBTOC assessment for MB use in this sector in 2018:** MBTOC notes that control of wood boring insects in infested areas in complete infested houses with heat has been common practice for many years around the world (Hammond, 2015). Phosphine, without added heat, is unlikely to be feasible because of slower action, with fully effective treatments taking several days against wood boring pests without added heat. Five target pests in the described situation are mentioned in the nomination – *Cryptotermes brevis*, the West Indian drywood termite; *Hylotrupes bajalus*, the European house borer, and the small wood and furniture beetles, *Anobium punctatum*, *Lyctus brunneus* and *Nicobium castaneum*. MBTOC notes that lethal ct-products against these pests differ significantly and are also dependent of temperature in the structure. The existing label does not address these differences. The Party is encouraged to seek flexibility for the fumigators to slightly adjust the dosages (for instance by allowing reduction from 48 g/m³ to 20 g/m³ in appropriate situations, such as higher temperatures) to avoid excessive use of MB and unnecessary emissions, despite pests being controlled effectively at lower dosages. Some particular specified insects (Lyctids and *Hylotrupes bajulus*) may require more than the regular label rate for control. While the termite can typically be controlled at 36 g/m³ or less particularly at higher temperature (>25°C). This part of the nomination distinguished between treatments for low level infestations of drywood termite, infestations of other wood destroying insects, particularly *Hylotrupes*, and multiple infestations of drywood termite with or without wood borers. Similar situations in the US, formerly treated with methyl bromide, are now mainly fumigated with sulfuryl fluoride (MBTOC Assessment reports 1998, 2002, 2006, 2010, 2014), but heat has also been used. Drywood termite infestations can typically be treated by the 'search-and-destroy' system where access is possible. In this process, the nests are located acoustically, electronically or with detector dogs and the located nests are eliminated by injection with appropriate, registered insecticide formulation. Baiting is not normally used, as the drywood termite nest, unlike subterranean termites are isolated in walls and ceilings and do not touch the soil.. Established infestations of *Hylotrupes* and other wood boring insects in structural timber are likely to require whole site treatment. Alternatives to methyl bromide include heat treatments at moderately elevated temperatures around 56°C (Dreger, 2007; Lewis and Haverty, 1996). The Party reported the accessibility of a portable Italian unit for release of 114 kW, quoted as a simple space heater. It has no modifications as required for heat treatments in houses, the connection to pipes would need modification. MBTOC recommends an amount of 42.75 tonnes. MBTOC has adjusted the nomination to a total of 42.75 tonnes to account for the implementation of 5% of the requested amount for the implementation of control with application of heat.

	MBTOC urges the Party to present more details on its development and demonstration program with alternatives against wood destroying pests in houses and similar structures and supports the approach to pursue registration of alternatives like sufuryl fluoride and ethyl formate to assist phase out of methyl bromide as quickly as possible for the use in this CUN. **MBTOC comments on economics for 2018:** The CUN rests mainly on the non-availability of SF not being registered material as yet, so no according economic analysis was conducted. Some information was presented on the fairly high investment costs for heating units that have to be bought abroad since they are not (yet) available in RSA. The Party stated that the difficulties to obtain even distribution of heat in the full area of infested roofs render this technique at present not feasible, despite the fact that the running cost for energy (heat production) and necessary amount of MB seem to be in the same range of about 0.35 Euro per m³. **Comments requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b(i) Emission Reduction:** The CUN states that partially in the sheeted houses a high level of fumigant containment has been achieved. • **Dec. IX/6 b(iii)Research Program:** MBTOC notes the recent favourable adoption of heat, but very limited work on trialling promising alternatives are given in the CUN. According to the CUN and additional correspondence, the Party is undertaking investigations in the suitability of heat disinfestation as possible alternative in South Africa for the described control of infestation. • **Dec. IX/6 b(iii)Appropriate Effort:** Sourcing and registration of one in-kind alternative is being sought for this use. • **Dec. Ex 1(4) Annex 1 National Management Strategy:** No detailed Management Strategy was presented. The Party indicated to phase out the MB use shortly after SF as an alternative will have been registered and accessible to the market.

[1]1ExMOP and 16MOP; [2]16MOP+2ExMOP+17MOP; [3]MOP17+MOP18; [4]MOP18+MOP19; [5]MOP19+MOP20; [6]MOP20+MOP21; [7]MOP21+MOP22; [8]MOP22, [9]MOP23, [10]MOP24,[11]MOP25

1.6 References:

Aldercreutz, E. G. A., Szczesny, A. (2010). Evaluación de tratamientos alternativos al bromuro de metilo realizados en el mismo período productivo en el cultivo de frutilla (*Fragaria x ananassa* Duch.) por el Proyecto Tierra Sana en el Cinturón Hortícola de Mar del Plata. No. 136 Horticultura. In: *Horticultura Argentina* 29(70): Sep.-Dic.

Aldercreutz, E. G. A., Szczesny, A. (2008). Tratamiento de suelos alternativos al bromuro de metilo en el cultivo de frutilla (*Fragaria* x *ananassa* Duch.) realizadas por el proyecto Tierra Sana en el cinturón hortícola de Mar del Plata. No. 149 Horticultura. In: *Horticultura Argentina* 27(64): Sep-Dic.

Andreau, R., Etchevers, P., Chale, W., Etcheverry, M., Calvo, M. Y., Génova, L. (2014). Injerto de tomate en La Plata: dos años de ensayos con pie Maxifort-copa Elpida conducidos bajo cubierta, bajo distintas condiciones de riego y drenaje. No. 019 Horticultura. In: *Horticultura Argentina* 33(82): Sep-Dic.

Anon (2013). International Standards for Phytosanitary Measures (ISPM 15). http://www.ispm15.com/IPPC%20ISPM15%20draft%20Apr%202013.pdf.

Ashraf, M. A., Kondo, N., Shiigi, T. (2011). Use of machine vision to sort tomato seedlings for grafting robot. *Engineering in Agriculture, Environment and Food* 4(4), 119-125.

Belda, C., Ribes-Dasi, M., Riudavets, J. 2011. Improving pest management in pet food mills using accurate monitoring and spatial analysis. *Journal of Stored Products Research* 47, 385-392.

Bell, C. H., Savvidou, N. (1999). The toxicity of Vikane (sulfuryl fluoride) to age groups of the Mediterranean flour moth (*Ephestia kuehniella*). *Journal of stored Products Research* 35, 233-247.

Bell, C. H., Wontner-Smith, T. J., Savvidou, N. (2003). Some properties of sulphur fluoride in relation to its use as a fumigant in the cereals industry. In: Credland, P. F., Armitage, D. M., Bell, C. H., Cogan P. M., Highley, E. (eds.), Advances in Stored Product Protection, *Proceedings of the 8th International Working Conference on Stored Product Protection*, 22-26 July in York, UK, CAB International, London, 910-915.

Bell, C. (2014). Pest control of stored food products: insects and mites. In: Lelieveld, H., Holah, J., Napper, D. (eds.), Hygiene in Food Processing: Principles and Practice (second edition), Woodhead Publishing Limited, Cambridge, UK.

Bórquez, A. M., Agüero, J. J. (2007). Evaluación del 1,3 diclorporopeno + cloropicrina y de la utilización del polietileno VIF con dosis reducida de bromuro de metilo 70:30 en la desinfección de suelo para el cultivo de frutilla, en Lules, Tucumán. No. 108. Horticultura. In: *Horticultura Argentina* 26(61): Jul.-Dic.

Bórquez, A. M., Mollinedo, V. A., (2009). Evaluación del uso del ioduro de metilo, metamsodio y metam amonio como alternativas al bromuro de metilopara la desinfección de suelo en frutilla. No. 128. Horticultura. In: *Horticultura Argentina* 28(67): Sep.-Dic.

Bórquez, A. M., Mollinedo, V. A, (2010). Evaluación de alternativas al bromuro de metilo como desinfectante de suelo en el cultivo de frutilla en Lules (Tucumán). No. 155. Horticultura. In: *Horticultura Argentina* 29(70): Sep.-Dic.

Budnik, L.T., Kloth, S., Velasco-Garrido, M., Baur, X. (2012). Prostate cancer and toxicity from critical use exemptions of methyl bromide: Environmental protection helps protect against human health risks. *Environmental Health* 11:5,12pp

Bulathsinghala AT1, Shaw IC. (2014). The toxic chemistry of methyl bromide. *Human Experimental Toxicology.* 2014 Jan;33(1):81-91. doi: 10.1177/0960327113493299.

Campbell, J. F., Arbogast, R. (2004). Stored-product insects in a flour mill: population dynamics and response to fumigation treatments. *Entomologia Experimentalis et Applicata* 112, 217-225.

Cabrera, A.J., Hanson, B.D., Abit, M.M., Gerik, J.S., Gao, S., Qin, R., Wang, D. (2015). Pre-plant soil fumigation with reduced rates under low permeable films for tree nursery production, orchard and vineyard replanting. *Crop Protection Journal.* 75:34-39.

Cao, A., Guo, M., Yan, D., Mao, L., Wang, Q., Li, Y., Duan, X. (2014). Evaluation of sulfuryl fluoride as a soil fumigant in China. *Pest Management Science* 70(2), 219-227.

Castillo, G., Ozores-Hampton M., Navia, P. (2016). Efficacy of drip injected fluensulfone in combination with 1,3-dichloropropene/chloropicrin to manage root-knot nematodes on fresh-market tomatoes. In: Obenauf, G. L. (ed.), *Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emission Reductions*, (MBAO), 8-10 November 2016 in Maitland, FL, USA, http://www.mbao.org, 4-1 – 4-4.

CDPR (2014). Approved tarpaulins for methyl bromide field fumigations – California www.cdpr.ca.gov/docs/emon/methbrom/tarps.pdf

Chale, W., Etcheverry, M., Génova, L., Etchevers, P., Calvo, I., Andreau, R., (2013). Ensayo comparativo de rendimiento de cinco injertos de tomate con copa Elpida en suelos con neinátodos conducidos bajo cubierta plastica en La Plata. No. 019 Horticultura. In: *Horticultura Argentina* 32(79): Sep.-Dic.

Christos, I. R., Ebrahim, M. K., Naved, S. (2011). Response of local and commercial tomato cultivars and rootstocks to *Meloidogyne javanica* infestation. *Australian Journal of Crop Science* 5(11), 1388-1395.

Chow E. (2016). An overview on the benefits of totally impermeable films for soil treatment. In: Obenauf, G. L. (ed.), *Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emission Reductions*, (MBAO), 8-10 November 2016 in Maitland, FL, USA, http://www.mbao.org, 10-1, 26 slides.

Cockburn, M., Mills, P., Zhang, X., Zadnick, J., Goldberg, D., Ritz, B. (2011). Prostate Cancer and Ambient Pesticide Exposure in Agriculturally Intensive Areas in California. *American Journal of Epidemiology* 173 (11):1280-1288.

Comba, L., Gay, P., Ricauda-Aimonino, D. (2016). Robot ensembles for grafting herbaceous crops. *Biosystems engineering* 146, 227-239.

Cristóbal-Alejo, J., Mora-Aguilera, G., Manzanilla-López, R. H., Marbán-Méndoza, N., Sánchez-Garcia, P., del Prado-Vera, I.C., Evans, K. (2006). Epidemiology and integrated control of *Nacobbus aberrans* on tomato in Mexico. *Nematology*, 8(5), 727 – 737.

De Souza, A., Kedareshwar P.S., Sindhoora, K.V. (2013). The neurological effects of methyl bromide intoxication. *Journal of Neurological Science* 335 (1-2), 36-41

Del Huerto Sordo, A. (2013). Se cultivaron 414 hectáreas de frutilla en la Provincia de Santa Fé. Boletín INTA, 3pp.

Devran, Z., Sogut, M.A. (2010). Occurrence of virulent root-knot nematode populations on toma toes bearing the Mi gene in protected vegetable-growing areas of Turkey. *Phytoparasitica* 38, 245-251.

Dreger, I. (2007). Thermal treatment with infrared radiation. An effective control measure against biotic wood-destroyers. In: Noldt, U., Michels, H. (eds.), Wood-Destroying Organisms in Focus - Alternative Measures for Preservation of Historic Buildings, *Proceedings of the International Conference at the LWL-Open Air Museum Detmold*, Westphalian Museum of Rural History and Culture, 28-30 June 2006, Detmold, Germany, ISBN 978-3-926160-42-3, 265 pp, 173-182.

Drinkall, M. J., Dugast, J. F., Reichmuth, Ch., Schöller M. (1996). The activity of the fumigant sulfuryl fluoride on stored product insects. In: Wildey, K. B. (ed.), *Proceedings of the 2nd International Conference on Insect Pests in the Urban Environment*, 7-10 July in Edinburgh, Scotland, UK, 525-528.

Drinkall, M. J., Zaffagnini, V., Süss, L., Locatelli, D. P. (2003). Efficacy of sulfuryl fluoride on stored-product insects in a semolina mill trial in Italy. In: Credland, P. F., Armitage, D. M., Bell, C. H., Cogan P. M., Highley, E. (eds.), Advances in Stored Product Protection, *Proceedings of the 8th International Working Conference on Stored Product Protection*, 22-26 July in York, UK, CAB International, London, 884-887.

Driver, J.G., Welker, R., Louws, F.J. (2011). Totally Impermeable films for fumigant rate reduction in North Carolina. *Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emission Reductions*, (MBAO), 9-11 November in San Diego, CA, USA,

Ducasse, A. M., Garbi, G., Morelli, M. C., Grimaldi, M., Somoza, J., Carbone, A., Cerisola, C., Martinez, S. (2013). Características de híbridos de tomate utilizados como pie de injerto cultivados en sualos con nematodos. No. 027. Horticultura. In: *Horticultura Argentina* 32 (79): Sep.-Dic.

Ducom, P., Dupuis, S., Stefanini, V., Guichard, A. A. (2003). Sulfuryl fluoride as a new fumigant for the disinfestations of flour mills in France. In: Credland, P. F., Armitage, D. M., Bell, C. H., Cogan P. M., Highley, E. (eds.), Advances in Stored Product Protection, *Proceedings of the 8th International Working Conference on Stored Product Protection*, 22-26 July in York, UK, CAB International, London, 900-903.

EPPO (2009). *Nacobbus aberrans sensulato*. EPPO Bull. 39, 376-381.

Fang, X., Phillips, D., Verheyen, G., Li, H., Sivasithamparam, K., Barbetti, M. J. (2012). Yields and resistance of strawberry cultivars to crown and root diseases in the field, and cultivar responses to pathogens under controlled environment conditions. *Phytopathologia Mediterranea* 51, 69-84.

Fery, R. L., Thies, J. A., Truhart, N. R. (2011). A root-knot nematode resistant, pimento-type pepper. *Hort. Science* 46, 815-816.

Gabriel, E. L. (2014). Evaluación de la biosolarización como alternativa para saneamiento de suelos en viveros de frutilla. No.162. Horticultura. In: *Horticultura Argentina* 33(82): Sep-Dic.

Garbi, M., Morelli, G., Dietz, N., Rossomano, G., Martinez, S. (2013). Respuesta de tres híbridos de tomate injertados sobre Maxifort cultivados en suelo biofumigado. No. 010. Horticultura. In: *Horticultura Argentina* 32(79): Sep.-Dic. 2013

García-Sinovas, D., Andrade, M. A., Becerril, M., De Cal, A., Redondo, C., Salto, T., Medina, J. J., Soria, C., López-Aranda, J. M., Martinez-Treceno, A. (2014). Soil disinfection in Spanish strawberry nurseries – three years without methyl bromide. *Acta Horticulturae* 1049, 691-696.

Gemmill, A., Gunier, R.B., Bradman, A., Eskenaz, B., Harley, K.G. (2013). Residential Proximity to Methyl Bromide Use and Birth Outcomes in an Agricultural Population in California. *Environmental Health Perspective* 121(6):737-743.

Guthman J. (2016). Strawberry growers wavered over methyl iodide, feared public backlash. Calif Agr 70(3), 124-129. DOI: 10.3733/ca.2016a0003.

Gutiérrez, M. T., Peralta, I. E., Conte, M. E., Hidalgo, A. A. (2013). Respuesta de porta injertos comerciales de tomate frente al falso nematodo del nudo, *Nacobbus aberrans* (Thorne, 1935)Thorne & Allen, 1944). No. 229 Horticultura. In: *Horticultura Argentina* 32(79): Sep-Dic.

Gutiérrez, M. T., Peralta, I. E., Conte, M. E., Hidalgo, A. A. (2014). Respuesta de cuatro porta injertos comerciales de tomate para consumo en fresco frente al falso nematodo del nudo *Nacobbus aberrans.* No. 005 Horticultura. In: *Horticultura Argentina* 33(82): Sep-Dic.

Hammond, D. (2015). Heat Treatment for Insect Control. Developments and Applications. Elsevier, 99 pp.

Hidalgo, C., Valadez Moctezuma, A. J. E., Marbán Mendoza, N. (2015). Effect of fluensulfone on the mobility in vitro, and reproduction and root galling of *Nacobbus aberrans* in microplots. *Nematropica* 45, 59-71.

Hoffmann, M., Miller, T., Rachuy, J., Dorn, N., Greene, I., Broome, J., Goodhue, R., Fennimore, S. (2015). Soil disinfestation with steam in California strawberry production. In: Obenauf, G. L. (ed.), *Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emission Reductions*, (MBAO), 9-11 November in San Diego, CA, USA, 18-1 – 18-4.

Huang, B., Li, J., Fang, W., Liu, P., Guo, P., Yan, D., Wang, Q., Cao, A. (2016). Effect of Soil Fumigation on Degradation of Pendimethalin and Oxyfluorfen in Laboratory and Ginger Field Studies. *J. Agric. Food Chem.* 64 (46): 8710–8721

Jari, S., Michael, M., Archana, P., Ted, R., Steve, F., Susan, M. (2011). Evaluations of tomato yellow leaf curl virus resistant varieties for commercial production. *The Food Provider,* June- July-August, 1-6.

Cristóbal-Alejo, J., Mora-Aguilera, G., Manzanilla-López, R.H., Marban-Méndoza, N., Sánchez-Garcia, P., Del Prado-Vera, C., Evans, K. (2006). Epidemiology and integrated control of *Nacobbus aberrans* on tomato in Mexico. *Nematology* 8(5), 727 – 737.

Ji, X., Qiao, K., Dong, S., Wang, H., Wang, K. (2013). Effects of 1,3-dichloropropene plus chloropicrin on weed seed germination. *Crop Protection* 45, 1-5.

Kubota, C., McClure, M. A., Kokalis-Burelle, N., Bausher, M. G., Rosskopf, E. N. (2008). Vegetable grafting: history, use, and current technology status in North America. *Horticultural Science* 43(6), 1664-1669.

Lax, P., Rondan Duenas, J. C., Coronel, N. B., Gardenal, C. N., Bima, P., Doucet, M. E. (2011). Host range study of Argentine *Nacobbus aberrans* sensu Sher populations and comments on the differential host test. *Crop Protection* 30, 1414-1420.

Lax, P., Rondan-Duenas, J. C., Ramos, D., Doucet, M. D., Braga, R., Kobori, R. (2016). Host suitability of peppers to the false root-knot nematode *Nacobbus aberrans. Crop Protection* 79, 15-19.

Lee, J.-M., Kubota, C., Tsao, S. J., Bie, Z., Echevarria, P. H., Morra, L. (2010). Current status of vegetable grafting: diffusion, grafting techniques, automation. *Scientia Horticulturae* 127(2), 93-105.

Lewis, V. R., Haverty, M. I. (1996). Evaluation of six techniques for control of the Western dry wood termite (Isoptera: Kalotermidae) in structures. *Journal of Economic Entomology* 89, 922-934.

Liangang M., Qiuxia W., Dongdong Y., Yuan L., Canbin O., Meixia G., Aocheng C. (2016). Flame soil disinfestation: A novel, promising, non-chemical method to control soilborne nematodes, fungal and bacterial pathogens in China. *Crop Protection* 83, 90-94.

Lobos, E.A., Occhionero, M.A., Occhionero, M., Werenitzky, D. (2013). Actividad nematicida de Neemazal 1.2. EC (Azadirachtina) en el control de *Meloidogyne* spp en el cultivo de tomate. No. 131 Horticultura. In: *Horticultura Argentina 32(79): Sep-Dic.*

López-Aranda, J.M., Domínguez, P., Miranda, L., de los Santos, B., Talavera, M., Daugovish, O., Soria, C., Chamorro, M., Medina, J.J. (2016): Fumigant Use for Strawberry Production in Europe: The Current Landscape and Solutions, *International Journal of Fruit Science*, DOI: 10.1080/15538362.2016.1199995

López-Galarza, S., San Bautista, A., Martínez, A., Pascual, B., Maroto, J. V. (2010). Influence of substrate on strawberry plug plant production. *Journal of Horticultural Science and Biotechnology* 85, 415-420.

Manzanilla-López, R., Costilla, M. A., Doucet, M., Franco, J., Inserra, R. N., Lehman, P. S., Cid Del Prado, I., Souza, R., Evans, K., (2002). *Nacobbus* species: Systematic, distribution, biology and management. *Nematropica* 32, 149-227.

Mao, L., Wang, Q., Yan, D., Ma, T., Liu, P., Sen, J., Li, Y., Ouyang, C., Guo M., Cao, A. (2014). Evaluation of chloropicrin as a soil fumigant against *Ralstonia solanacearum* in ginger (*Zingiber officinale* Rosc.) production in China. PLoS ONE 9(3): e91767 doi:10.1371/journal.pone.0091767

Martínez, S., Morelli, G., Garbi, M., Barrenechea, M., Notar, S., Ludueña, M. (2013). Evaluación del efecto de diferentes porta injertos de tomate sobre la respuesta de un híbrido comercial. No. 024. Horticultura. En: *Horticultura Argentina 32(79): Sep. -Dic.*

Mattner, S. W., Gounder, R. K., Porter, I. J., Mann, R. C., de Boer, D., Williams, E., Guijarro, B., Rose, G., Allen, D., Horner, I. J., Allison, C., Coram, S., Fraser, P., Reiss, R., Taylor, P. (2012). Maintaining biosecurity standards for soilborne pathogens and weeds in the strawberry runner industry. *Horticulture Australia Limited*, Final Report, Project No. BS07014. Sydney, NSW.

Mattner, S. W., Horstra, C. B., Milinkovic, M., Merriman, P. R., Greenhalgh, F. C. (2017). Evaluation of soil-less systems for strawberry transplant production in Australia. *Acta Horticulturae* (In Press)

Mattner, S., Milinkovic, M., Horstra, C., Greenhalgh, F., Welker, R., Tan, D., Horvath, A. (2015). Efficacy and plant-back of DMDS in the Australian strawberry nursery industry. In: Obenauf, G. L. (ed.), *Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emission Reductions*, (MBAO), November 9-11, San Diego, California, USA, 73-1 – 73-4, poster as slide.

Mattner, S. W., Milinkovic, M., Merriman, P. R., Porter, I. J. (2014). Critical challenges for the phase-out of methyl bromide in the Australian strawberry industry. *Acta Horticulturae*. 1044, 367-373.

MBTOC (2011). Report of the Methyl Bromide Technical Options Committee. 2010 Assessment. UNEP, Nairobi, Kenya, 335 pp.

MBTOC (2015). Report of the Methyl Bromide Technical Options Committee. 2014 Assessment. UNEP, Nairobi, Kenya, 278 pp.

McCall, J., Harris, D., and Berk, M (2016). Examination of the Effects of Chronic Exposure to Federally-Regulated and Approved Levels of Methyl Bromide in Dock Workers: A Case Series (S8.003) *Neurology* April 5, 86 no. 16 Supplement S8.003

Mezquíriz, N., Polack, L. A., Amoia, P. R., Villagra, J., Busse, G. (2013). Evaluación de alternativas para controlar patógenos de suelo y nematodos en tomate bajo invernadero. No. 144 Horticultura. En: *Horticultura Argentina* 32(79): Sep-Dic.

Minuto, A., Gullino, M. L., Lamberti, F., D'Addabbo, T., Tescari, E., Ajwa, H., Garibaldi, A. (2006). Application of an emulsifiable mixture of 1,3-dichloropropene and chloropicrin against root knot nematodes and soilborne fungi for greenhouse tomatoes in Italy. *Crop Protection* 25, 1244–1252.

Miranda, F.R., da Silva, V.B., dos Santos, F.S.R., Rosetti, A.G., da Silva, C.B. (2014). Production of strawberry cultivars in closed hydroponic systems and coconut fibre substrate. *Revista Ciência Agronômica*, 45 (4), 833-841

Mitidieri, M. S., Brambilla, M. V., Piris, M., Maldonado, L. (2005). El uso de portainjertos resistentes en cultivo de tomate bajocubierta: resultados sobre la sanidad y el rendimiento del cultivo. INTA, Estacion. Experimental Agropecuaria San Pedro, Argentina

Mitideri, M. S., Piris, E., Brambilla, V., Barbieri, M., Cap, G., González, J., Del Prado, K., Ciapone, M., Paunero, I., Schiavone, E., Celié, R., Arpía, E., Peralta, R., Verón, R., Sánchez, F. (2013). Evaluación de Solanum sisymbriifolium (Lam) como pie de injerto en cultivo de tomate bajo cubierta. No. 026 Horticultura. In: *Horticultura Argentina* 32(79): Sep-Dic.

MLF, (2014a). Multilateral Fund Secretariat for the Montreal Protocol. Policy 71 Plans to December 2013. Montreal, Canada, 845 pp (pdf document)

MLF, (2014b). Multilateral Fund Secretariat for the Montreal Protocol. MB Projects Database. Montreal, Canada, 154 pp (pdf document).

OEPP/EPPO (1984) Data sheets on quarantine organisms. No. 144, *Nacobbus aberrans.* Bulletin OEPP/EPPO Bulletin 14, 61-66.

Osbrink, W.L.A., Scheffrahn, R.H., Su, N.Y., Rust, M.K. (1987) Laboratory comparisons of sulfuryl fluoride toxicity and mean time of mortality among ten termite species. *J. Econ. Entomol.* 80,1044–1047

Osbrink, W. L. A., Scheffrahn, R. H., Hsu, R.-C., Su, N.-Y. (1988). Sulfuryl fluoride residues of fumigated foods protected by polyethylene film. Journal of Agriculture and Food Chemistry 36, 853-855.

Pérez-Rodríguez, I., Franco-Navarro, F., Cid del Prado-Vera, Zavaleta-Mejía I. E. (2010). Control of *Nacobbus aberrans* in chili pepper (*Capsicum annuum* L.) by the combination of organic amendments, nematophagous fungi and nematicides. *Nematropica* 41, 122-129.

Porter, I. J., Trinder, L., Partington, D. (2006). Special report validating the yield performance of alternatives to methyl bromide for preplant fumigation. *TEAP/MBTOC Special Report*, UNEP Nairobi, May 2006, 97 pp.

Qiao, K., Yukun, Z., Hongyan, W., Xiaoxue, J., Kaiyun, W. (2012). Effects of 1,3-dichloropropene as a methyl bromide alternative for management of nematode, soil-borne disease, and weed in ginger (*Zingiber officinale*) crops in China. *Crop Protection* 32, 71-75.

Quiroga, R. J., Meneguzzi, N. G., Borquez, A. M., Kirschbaum, D. S. (2014). Dinámica de la temperatura a diferentes profundidades durante la solarización de un suelo franco-limoso en Tucumán. No. 115 Horticultura. En: *Horticultura Argentina* 33(82): Sep-Dic.

Rambeau, M., Benitez, D., Dupuis, A.S., Ducom, P. (2001). Hydrogen cyanide as an intermediate alternative to methyl bromide for structural fumigations. In: Donahaye J.E., Navarro S., Leesch J.G. (eds): *Proceedings International Conference on Controlled Atmosphere and Fumigation in Stored Products*, Fresno, USA, Oct 29–Nov 3, 2000.Clovis, Executive Printing Services: 101–111.

Reichmuth, Ch., Rassmann, W., Binker, G., Fröba, G., Drinkall, M. J. (2003). Disinfestation of rust-red flour beetle (*Tribolium castaneum*), saw-toothed grain beetle (*Oryzaephilus surinamensis*), yellow meal worm (*Tenebrio molitor*), Mediterranean flour moth (*Ephestia kuehniella*), and Indian meal moth (Plodia interpunctella) with sulfuryl fluoride in flour mills. In: Credland, P. F., Armitage, D. M., Bell, C. H., Cogan P. M., Highley, E. (eds.), Advances in Stored Product Protection, *Proceedings of the 8th International Working Conference on Stored Product Protection*, 22-26 July in York, UK, CAB International, London, 736-738.

Reichmuth, Ch. (2007). Fumigants for pest control in wood protection. In: Noldt, U., Michels, H. (eds.), Wood–destroying Organisms in Focus – Alternative Measures for Preservation of Historical Buildings. Proceedings of the International Conference at the LWL-Open Air Museum Detmold, Westphalian Museum of Rural History and Culture, 28-30 June 2006 in Detmold, Germany, 265 pp., 137-162.

Reichmuth, Ch. (2002). Alternatives to methyl bromide for the treatment of wood, timber and artefacts in the European Community. In: Batchelor, T. A., Bolivar, J. M., eds., The remaining Challenges, *Proceedings of an International Conference on Alternatives to Methyl Bromide*, 5-8 March 2002 in Sevilla, Spain, European Commission, Brussels, Belgium, 432 pp., 93-97, http://ec.europa.eu/clima/events/docs/0039/conference_proceedings_en.pdf.

Rodríguez-Delfín, A. (2012). Advances of hydroponics in Latin America. *Acta Horticulturae* 947, 23-32.

Rodrigues de Miranda, F., Barros da Silva, V., Ribeiro dos Santos, F. S., Guimarães Rossetti, A., Brucede Fatima, C. (2014). Production of strawberry cultivars in closed hydroponic systems and coconut fibre substrate. *Revista Ciência Agronômica 45*(4), 833-841.

Sass, J. (2015). Methyl Bromide pesticide - long banned for indoor home uses -suspected of severely poisoning a family after vacation home is fumigated. https://www.nrdc.org

Schneider, B. M., Hartsell, P. L. (1999). Control of stored product pests with Vikane gas fumigant (sulfuryl fluoride). In: Zuxun, J., Quan, L., Yongsheng, L., Xianchang, T., Lianhua, G. (eds.), *Proceedings of the 7th International Working Conferece on Stored-Product Protection*, 14-19 October 1998 in Beijing, P. R. China, Sichuan Publishing House of Science & Technology, Oct. 1999, Chengdu Province, P. R. China, Vol. 1, 406-408.

Sisler, G. M. de, Casaurang, A. P. de (1983). Reacci on de cultivares de tomate y pimiento a *Nacobbus aberrans* (Nematoda, Nacobbidae). *Rev. la Fac. Agron*. 4, 79-82.

Sjulin, T., Greene, I. (2011). Growing Strawberries in: Substrates:Challenges and Opportunities, California Strawberry Commission; presentation available in http://cesantabarbara.ucanr.edu/files/75478.pdf.

Stewart D. (1957). Sulfuryl fluoride - a new fumigant for control of the drywood termite *Kalotermes minor* Hagen. *J Econ. Entomol.* 50, 7-11.

Stone, A. R., Burrows, P. R. (1985). *Nacobbus aberrans*. CIH Descriptions of Plant-Parasitic Nematodes No. 119. CAB International, Wallingford, UK.

Thalavaisundaram, T., Mattner, S., Milinkovic, M. T., Ridley, R., Greenhalgh, F. (2015). VIF improves the efficacy of EDN® Fumigas in the Australian Strawberry Nursery Industry. In: Obenauf, G. L. (ed.), *Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emission Reductions*, (MBAO), 9-11 November in San Diego, CA, USA, 4-1 - 4-4, 18 slides.

Trematerra, P., Gentile, P., Brunetti, A., Collins, L.E., Chambers, J. (2007). Spatiotemporal analysis of trap catches of *Tribolium confusum* du Val in a semolina mill, with a comparison of female and male distributions. *Journal of stored Products Research* 43, 315-322.

Valdez, I., Jaldo, H. E., Foros, A. C., Ale, J. (2007). Ensayo de alternativas químicas al bromuro de metilo. Lules, Tucumán. No. 079. Horticultura. In: *Horticultura Argentina* 26(61): Jul-Dic.

Veremis, J. C., Cap, G. B., Roberts, P. A. (1997). A search for resistance in *Lycopersicon* spp. to *Nacobbus aberrans***.** *Plant Disease* 81, 217-221.

Wang, Q., Yan, D., Mao, L., Ma, T., Liu, P., Wu, Z., Li, Y., Cao, A. (2013). Efficacy of 1,3-dichloropropene plus chloropicrin gelatin capsule formulation for the control of soilborne pests. *Crop Protection* 33, 24-2.

Weiland, J. E., Littke, W. R., Browning, J. E., Edmonds, J. L., Davis, A., Beck, B. R., Miller, T. W. (2016) Efficacy of reduced rate fumigant alternatives and methyl bromide against soilborne pathogens and weeds in western forest nurseries. *Crop Protection* 85, 57-64.

Yamano, Y., Kagawa, J., Ishizu, S., (2001). Two cases of methyl bromide poisoning in termite exterminators. *Journal of Occupational Health* 43, 291–294

Yamano, Y., Nakadate, T. (2006). Three occupationally exposed cases of severe methyl bromide poisoning: accident caused by a gas leak during the fumigation of a folklore museum. *Journal of Occupational Health.* 48(2),129-33.

Yang, G., Huang, G., Wei, D., Qin, C., Yang, R. (2011) Effect of different dazomet doses on controlling *Ralstonia solanacearum* of gingers. *China Vegetables* 12, 85-87.

Yang, X., Gao, D., Han, J., Liu, F. (2011) Toxicity of dazomet and chloropicrin to soil-borne pathogens of ginger. *Chinese Journal of Pesticide Science* 13, 331-334.

ANNEX I:

Decision IX/6 Critical Use Exemptions for Methyl Bromide

1. To apply the following criteria and procedure in assessing a critical methyl bromide use for the purposes of control measures in Article 2 of the Protocol:

(a) That a use of methyl bromide should qualify as "critical" only if the nominating Party determines that:

(i) The specific use is critical because the lack of availability of methyl bromide for that use would result in a significant market disruption; and

(ii) There are no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination;

(b) That production and consumption, if any, of methyl bromide for critical uses should be permitted only if:

(i) All technically and economically feasible steps have been taken to minimise the critical use and any associated emission of methyl bromide;

(ii) Methyl bromide is not available in sufficient quantity and quality from existing stocks of banked or recycled methyl bromide, also bearing in mind the developing countries' need for methyl bromide;

(iii) It is demonstrated that an appropriate effort is being made to evaluate, commercialise and secure national regulatory approval of alternatives and substitutes, taking into consideration the circumstances of the particular nomination and the special needs of Article 5 Parties, including lack of financial and expert resources, institutional capacity, and information. Non-Article 5 Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes. Article 5 Parties must demonstrate that feasible alternatives shall be adopted as soon as they are confirmed as suitable to the Party's specific conditions and/or that they have applied to the Multilateral Fund or other sources for assistance in identifying, evaluating, adapting and demonstrating such options;

2. To request the Technology and Economic Assessment Panel to review nominations and make recommendations based on the criteria established in paragraphs 1 (a) (ii) and 1 (b) of the present decision;

3. That the present decision will apply to Parties operating under Article 5 and Parties not so operating only after the phase-out date applicable to those Parties.

Para. 2 of Decision IX/6 does not assign TEAP the responsibility for determining the existence of "significant market disruption" specified in paragraph 1(a)(i).

TEAP assigned its Methyl Bromide Technical Options Committee (MBTOC) to determine whether there are no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination, and to address the criteria listed in Decision IX/6 1(b).

ANNEX II:

Decision Ex.I/4. Conditions for granting and reporting critical-use exemptions for methyl bromide

Mindful of the principles set forth in the report[1] by the chair of the informal consultation on methyl bromide held in Buenos Aires on 4 and 5 March 2004, namely, fairness, certainty and confidence, practicality and flexibility, and transparency,

Recognizing that technically and economically feasible alternatives exist for most uses of methyl bromide,

Noting that those alternatives are not always technically and economically feasible in the circumstances of nominations,

Noting that Article 5 and non-Article 5 Parties have made substantial progress in the adoption of effective alternatives,

Mindful that exemptions must comply fully with decision IX/6 and are intended to be limited, temporary derogations from the phase-out of methyl bromide,

Recognizing the desirability of a transparent presentation of data on alternatives to methyl bromide to assist the Parties to understand better the critical-use volumes and to gauge progress on and impediments to the transition from methyl bromide,

Resolved that each Party should aim at significantly and progressively decreasing its production and consumption of methyl bromide for critical uses with the intention of completely phasing out methyl bromide as soon as technically and economically feasible alternatives are available,

Recognizing that Parties should revert to methyl bromide only as a last resort, in the event that a technically and economically feasible alternative to methyl bromide which is in use ceases to be available as a result of de-registration or for other reasons,

3. That each Party which has an agreed critical use under the present decision should submit available information to the Ozone Secretariat before 1 February 2005 on the alternatives available, listed according to their pre-harvest or post-harvest uses and the possible date of registration, if required, for each alternative; and on the alternatives which the Parties can disclose to be under development, listed according to their pre-harvest or post-harvest uses and the likely date of registration, if required and known, for those alternatives, and that the Ozone Secretariat shall be requested to provide a template for that information and to post the said information in a database entitled "Methyl Bromide Alternatives" on its web site;

4. That each Party which submits a nomination for the production and consumption of methyl bromide for years after 2005 should also submit information listed in paragraph 1 to the Ozone Secretariat to include in its Methyl Bromide Alternatives database and that any other Party which no longer consumes methyl bromide should also submit information on alternatives to the Secretariat for inclusion in that database;

5. To request each Party which makes a critical-use nomination after 2005 to submit a national management strategy for phase-out of critical uses of methyl bromide to the Ozone Secretariat before 1 February 2006. The management strategy should aim, among other things:

(a) To avoid any increase in methyl bromide consumption except for unforeseen circumstances;

(b) To encourage the use of alternatives through the use of expedited procedures, where

[1] UNEP/OzL.Pro.ExMP/1/INF/1, para. 11.

possible, to develop, register and deploy technically and economically feasible alternatives;

(c) To provide information, for each current pre-harvest and post-harvest use for which a nomination is planned, on the potential market penetration of newly deployed alternatives and alternatives which may be used in the near future, to bring forward the time when it is estimated that methyl bromide consumption for such uses can be reduced and/or ultimately eliminated;

(d) To promote the implementation of measures which ensure that any emissions of methyl bromide are minimized;

(e) To show how the management strategy will be implemented to promote the phase-out of uses of methyl bromide as soon as technically and economically feasible alternatives are available, in particular describing the steps which the Party is taking in regard to subparagraph (b) (iii) of paragraph 1 of decision IX/6 in respect of research programmes in non-Article 5 Parties and the adoption of alternatives by Article 5 Parties;

6. To request the Meeting of the Parties to take into account information submitted pursuant to paragraphs 1 and 3 of the present decision when it considers permitting a Party to produce or consume methyl bromide for critical uses after 2006;

7. To request a Party that has submitted a request for a critical use exemption to consider and implement, if feasible, Technology and Economic Assessment Panel and Methyl Bromide Technical Options Committee recommendations on actions which a Party may take to reduce critical uses of methyl bromide;

8. To request any Party submitting a critical-use nomination after 2004 to describe in its nomination the methodology used to determine economic feasibility in the event that economic feasibility is used as a criterion to justify the requirement for the critical use of methyl bromide, using as a guide the economic criteria contained in section 4 of annex I to the present report;

9. To request each Party from 1 January 2005 to provide to the Ozone Secretariat a summary of each crop or post-harvest nomination containing the following information:

(a) Name of the nominating Party;

(b) Descriptive title of the nomination;

(c) Crop name (open field or protected) or post-harvest use;

(d) Quantity of methyl bromide requested in each year;

(e) Reason or reasons why alternatives to methyl bromide are not technically and economically feasible;

10. To request the Ozone Secretariat to post the information submitted pursuant to paragraph 7 above, categorized according to the year in which it was received, on its web site within 10 days of receiving the nomination;

11. To request the Technology and Economic Assessment Panel:

(a) To identify options which Parties may consider for preventing potential harmful trade of methyl bromide stocks to Article 5 Parties as consumption is reduced in non-Article 5 Parties and to publish its evaluation in 2005 to enable the Seventeenth Meeting of the Parties to decide if suitable mitigating steps are necessary;

(b) To identify factors which Article 5 Parties may wish to take into account in evaluating whether they should either undertake new accelerated phase-out commitments through the Multilateral Fund for the Implementation of the Montreal Protocol or seek changes to already agreed accelerated phase-outs of methyl bromide under the Multilateral Fund;

(c) To assess economic infeasibility, based on the methodology submitted by the nominating Party under paragraph 6 above, in making its recommendations on each critical-use nomination. The report by the Technology and Economic Assessment Panel should be made with a view to encouraging nominating Parties to adopt a common approach in assessing the economic feasibility of alternatives;

(d) To submit a report to the Open-ended Working Group at its twenty-sixth session on the possible need for methyl bromide critical uses over the next few years, based on a review of the management strategies submitted by Parties pursuant to paragraph 3 of the present decision;

(e) To review critical-use nominations on an annual basis and apply the criteria set forth in decision IX/6 and of other relevant criteria agreed by the Parties;

(f) To recommend an accounting framework for adoption by the Sixteenth Meeting of the Parties which can be used for reporting quantities of methyl bromide produced, imported and exported by Parties under the terms of critical-use exemptions, and after the end of 2005 to request each Party which has been granted a critical-use exemption to submit information together with its nomination using the agreed format;

(g) To provide, in consultation with interested Parties, a format for a critical-use exemption report, based on the content of annex I to the present report, for adoption by the Sixteenth Meeting of the Parties, and to request each Party which reapplies for a methyl bromide critical-use exemption after the end of 2005 to submit a critical-use exemption report in the agreed format;

(h) To assess, annually where appropriate, any critical-use nomination made after the end of 2006 in the light of the Methyl Bromide Alternatives database information submitted pursuant to paragraph 1 of the present decision, and to compare, annually where appropriate, the quantity, in the nomination, of methyl bromide requested and recommended for each pre-harvest and post-harvest use with the management strategy submitted by the Party pursuant to paragraph 3 of the present decision;

(i) To report annually on the status of re-registration and review of methyl bromide uses for the applications reflected in the critical-use exemptions, including any information on health effects and environmental acceptability;

(j) To report annually on the status of registration of alternatives and substitutes for methyl bromide, with particular emphasis on possible regulatory actions that will increase or decrease dependence on methyl bromide;

(k) To modify the handbook on critical-use nominations for methyl bromide to take the present decision and other relevant information into account, for submission to the Sixteenth Meeting of the Parties.

ANNEX III - Part A: Historic Trends in non A5 Preplant Soil Nominations and Exemptions for Uses of MB reported to have been phased out

List of nominated (2005 – 2015) and exempted (2005 – 2015) amounts of MB granted by Parties under the CUE process for each crop.

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Australia	Cut Flowers – field	40.000	22.350											18.375	22.350										
Australia	Cut flowers – protected	20.000												10.425											
Australia	Cut flowers, bulbs – protected Vic	7.000	7.000	6.170	6.150									7.000	7.000	3.598	3.500								
Australia	Strawberry Fruit	90.000												67.000											
Australia	Strawberry runners	See Section 1.2.4																							
Belgium	Asparagus	0.630	0.225											0.630	0.225										
Belgium	Chicory	0.600	0.180											0.180	0.180										
Belgium	Chrysanthem ums	1.800	0.720											1.120											
Belgium	Cucumber	0.610	0.545											0.610	0.545										
Belgium	Cut flowers – other	6.110	1.956											4.000	1.956										
Belgium	Cut flowers – roses	1.640																							
Belgium	Endive (sep from lettuce)		1.650												1.650										
Belgium	Leek & onion seeds	1.220	0.155											0.660											
Belgium	Lettuce(& endive)	42.250	22.425											25.190											

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	Nursery	Not Predictable	0.384											0.900	0.384										
Belgium	Orchard pome & berry	1.350	0.621											1.350	0.621										
Belgium	Ornamental plants	5.660												0.000											
Belgium	Pepper & egg plant	5.270	1.350											3.000	1.350										
Belgium	Strawberry runners	3.400	0.900											3.400	0.900										
Belgium	Tomato (protected)	17.170	4.500											5.700	4.500										
Belgium	Tree nursery	0.230	0.155											0.230	0.155										
Canada	Strawberry runners (PEI)	See Section 1.2.4																							
Canada	Strawberry runners (Quebec)		1.826	1.826										(a)	1.826	1.826									
Canada	Strawberry runners (Ontario)			6.129												6.129									
France	Carrots	10.000	8.000	5.000										8.000	8.000	1.400									
France	Cucumber	85 revised to 60	60.000	15.000										60.000	60.000	12.500									
France	Cut-flowers	75.000	60.250	12.000										60.000	52.000	9.600									
France	Forest tree nursery	10.000	10.000	1.500										10.000	10.000	1.500									
France	Melon	10.000	10.000											7.500	6.000										
France	Nursery: orchard, raspberry	5.000	5.000	2.000										5.000	5.000	2.000									
France	Orchard replant	25.000	25.000	7.500										25.000	25.000	7.000									
France	Pepper	Inclin.tomato cun	27.500	6.000											27.500	6.000									

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
France	Strawberry fruit	90.000	86.000	34.000										90.000	86.000										
France	Strawberry runners	40.000	4.000	35.000										40.000	40.000	28.000									
France	Tomato (and eggplant for 2005 only)	150(all solanaceous)	60.500	33.250										125.000	48.400										
France	Eggplant		27.500	33.250											48.400										
Greece	Cucurbits	30.000	19.200											30.000	19.200										
Greece	Cut flowers	14.000	6.000											14.000	6.000										
Greece	Tomatoes	180.000	73.600											156.000	73.600										
Israel	Broomrape			250.000	250.000	125.000	12.500	12.500								250.000	250.000	125.000	12.500						
Israel	Cucumber - protected new 2007			25.000	18.750		18.750	12.500								25.000	18.750	-	15.937						
Israel	Cut flowers – open field	77.000	67.000	80.755	53.345	42.777	42.554	23.292						77.000	67.000	74.540	44.750	34.698	28.554						
Israel	Cut flowers – protected	303.000	303.000	321.330	163.400	113.821	72.266	52.955						303.000	240.000	220.185	114.450	85.431	63.464						
Israel	Fruit tree nurseries	50.000	45.000	10.000										50.000	45.000	7.500									
Israel	Melon – protected & field	148.000	142.000	140.000	87.500	87.500	87.500	35.000						125.650	99.400	105.000	87.500	87.500	70.000						
Israel	Potato	239.000	231.000	137.500	93.750	75.000								239.000	165.000	137.500	93.750	75.000							
Israel	Seed production	56.000	50.000			22.400								56.000	28.000			NR							
Israel	Strawberries – fruit (Sharon)	196.000	196.000	176.200	64.125	52.250	47.500	28.500						196.000	196.000	93.000	105.960	42.750							
Israel	Strawberries – fruit (Sharon &Ghaza)																		57.063						

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Israel	Strawberry runners (Sharon)	35.000	35.000		20.000	15.800	13.570	13.500						35.000	35.000	28.000	31.900	15.825							
Israel	Strawberry runners and fruit Ghaza				87.875	67.500	67.500	34.000										47.250							
Israel	Strawberry runners (Sharon &Ghaza)																		22.320						
Israel	Tomatoes			90.000												22.750									
Israel	Sweet potato					95.000	20.000	20.000									111.500	95.000	20.000						
Italy	Cut flowers (protected)	250.000	250.000	30.000										250.000	187.000	30.000									
Italy	Eggplant (protected)	280.000	200.000	15.000										194.000	156.000										
Italy	Melon (protected)	180.000	135.000	10.000										131.000	131.000	10.000									
Italy	Pepper (protected)	220.000	160.000	67.000										160.000	130.000	67.000									
Italy	Strawberry Fruit (Protected)	510.000	400.000	35.000										407.000	320.000										
Italy	Strawberry Runners	100.000	120.000	35.000										120.000	120.000	35.000									
Italy	Tomato (protected)	1300.000	1030.00	418.000										871.000	697.000	80.000									
Japan	Cucumber	88.300	88.800	72.400	68.600	61.400	34.100	29.120	26.162					88.300	88.800	72.400	51.450	34.300	30.690	27.621					
Japan	Ginger – field	119.400	119.400	112.200	112.100	102.200	53.400	47.450	42.235					119.400	119.400	109.701	84.075	63.056	53.400	47.450					
Japan	Ginger – protected	22.900	22.900	14.800	14.800	12.900	8.300	7.770	6.558					22.900	22.900	14.471	11.100	8.325	8.300	7.036					
Japan	Melon	194.100	203.900	182.200	182.200	168.000	90.800	77.600	67.936					194.100	203.900	182.200	136.650	91.100	81.720	73.548					

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Japan	Peppers (green and hot)	189.900	200.700	169.400	162.300	134.400	81.100	68.260	61.101					187.200	200.700	156.700	121.725	81.149	72.990	65.691					
Japan	Watermelon	126.300	96.200	94.200	43.300	23.700	15.400	13.870	12.075					129.000	98.900	94.200	32.475	21.650	14.500	13.050					
Malta	Cucumber		0.096												0.127										
Malta	Eggplant		0.128												0.170										
Malta	Strawberry		0.160												0.212										
Malta	Tomatoes		0.475												0.594										
New Zealand	Nursery material	1.085	1.085												0										
New Zealand	Strawberry fruit	42.000	42.000	24.78										42.000	34.000	12.000									
New Zealand	Strawberry runners	10.000	10.000	5.720										8.000	8.000	6.234									
Poland	Strawberry Runners	40.000	40.000	25.000	12.000									40.000	40.000	24.500									
Portugal	Cut flowers	130.000	8.750											50.000	8.750										
Spain	Cut Flowers – Cadiz	53.000	53.000	35.000										53.000	42.000										
Spain	Cut Flowers – Catalonia	20.000	18.600	12.840	17 (+Andalucia)									20.000	15.000 (+Andaluci a)	43.490									
Spain	Pepper	200.000	155.000	45.000										200.000	155.000	45.000									
Spain	Strawberry Fruit	556.000	499.290	80.000										556.000	499.290	0.0796									
Spain	Strawberry Runners	230.000	230.000	230.000	215.000									230.000	230.000	230.000									
UK	Cut flowers		7.560												6.050										
UK	Ornamental tree nursery	12.000	6.000											6.000	6.000										

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
UK	Strawberry (& raspberry in 2005)	80.000	63.600											68.000	54.500										
UK	Raspberry nursery		4.400											4.400	54.500										
USA	Chrys. Cuttings/roses	29.412												29.412	0										
USA	Cucurbits – field	1187.8	747.839	598.927	588.949	411.757	340.405	218.032	59.500	11.899				1187.800	747.839	592.891	486.757	407.091	302.974	195.698	59.500				
USA	Eggplant – field	76.761	101.245	96.48	79.546	62.789	34.732	21.561	6.904	1.381				76.721	82.167	85.363	66.018	48.691	32.820	19.725	6.904				
USA	Forest nursery seedlings	192.515	157.694	152.629	133.140	125.758	120.853	106.043						192.515	157.694	122.032	131.208	122.060	117.826	93.547					
USA	Ginger	9.2												9.2	0										
USA	Orchard replant	706.176	827.994	405.415	405.666	314.007	226.021	203.591	18.324	6.230				706.176	527.600	405.400	393.720	292.756	215.800	183.232	18.324				
USA	Ornamentals	210.949	162.817	149.965	138.538	137.776	95.204	70.178	48.164	48.164				154.000	148.483	137.835	138.538	107.136	84.617	64.307	48.164				
USA	Nursery stock - fruit trees, raspberries, roses	45.789	64.528	12.684	51.102	27.663	17.954	7.955	1.591	0.541				45.800	64.528	28.275	51.102	25.326	17.363	7.955	1.591				
USA	Peppers – field	1094.782	1498.53	1151.751	919.006	783.821	463.282	212.775	28.366					1094.782	1243.542	1106.753	756.339	548.984	463.282	206.234					
USA	Strawberry fruit – field	2468.873	1918.40	1733.901	1604.669	1336.754	1103.422	1023.471	753.974	610.339	415.067	373.660	231.540	2052.846	1730.828	1476.019	1349.575	1269.321	1007.477	812.709	678.004	532.442	415.067	373.660	231.540
USA	Strawberry runners	54.988	56.291	4.483	8.838	8.837	7.381	7.381	3.752	3.752				54.988	56.291	4.483	8.838	7.944	4.690 + 2.018	6.036	3.752				
USA	Tomato – field	2876.046	2844.985	2334.047	1840.1	1406.484	994.582	336.191	54.423	10.741				737.584	2476.365	2065.246	1406.484	1003.876	737.584	292.751	54.423				
USA	Turfgrass	352.194	131.600	78.040	52.189	0									131.600	78.04	0								

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
USA	Sweet potato	224.528			18.144	18.144	18.144	14.515	8.709								18.144	18.144	14.515	11.612					
USA	Research								2.768	2.768															

ANNEX IV– Part B: Historic Trends in non A5 Structural and Commodity Nominations and Exemptions for Uses of MB reported to have been phased out

List of nominated (2005- 2016) and exempted (2005 - 2016) amounts of MB granted by Parties under the CUE process for each commodity.

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Australia	Almonds	1.900	2.100											1.900	2.100										
Australia	Rice consumer packs	12.300	12.300	10.225	9.200 +1.8	9.2	7.82	5.66	3.653	2.374	1.187	1.187		6.150	6.150	9.205	9.200	7.820	6.650	4.870	3.653	1.187	1.187		
Belgium	Artefacts and structures	0.600	0.307											0.590	0.307										
Belgium	Antique structure & furniture	0.750	0.199											0.319	0.199										
Belgium	Churches, monuments and ships' quarters	0.150	0.059											0.150	0.059										
Belgium	Electronic equipment	0.100	0.035											0.100	0.035										
Belgium	Empty silo	0.050	0.043											0.050	0.043										
Belgium	Flour mill see mills below	0.125	0.072											See mills below	0.072										
Belgium	Flour mills	10.000	4.170											9.515	4.170										
Belgium	Mills	0.200	0.200											0.200	0.200										
Belgium	Food processing facilities	0.300	0.300											0.300	0.300										
Belgium	Food Processing premises	0.030	0.030											0.030	0.030										

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	Food storage (dry) structure	0.120	0.120											0.120	0										
Belgium	Old buildings	7.000	0 .306											1.150	0.306										
Belgium	Old buildings and objects	0.450	0.282											0	0.282										
Belgium	Woodworkin g premises	0.300	0.101											0.300	0.101										
Canada	Flour mills	47.200	34.774	30.167	28.650	26.913	22.878	14.107	11.020	7.848	5.044	**5.044**		(a)47	34.774	30.167	28.65	26.913	22.878	14.107	11.020	5.044	**5.044**		
Canada	Pasta manufacturin g facilities	(a)	10.457	6.757	6.067	4.740	4.740	2.084						(a)	10.457	6.757	6.067	4.740	3.529						
Canada	Commodities					0.068																			
France	Seeds sold by PLAN-SPG company	0.135	0.135	0.100										0.135	0.135	0.096									
France	Mills	55.000	40.000	8.000										40.000	35.000	8.000									
France	Rice consumer packs	2.000	2.000											2.000	2.000										
France	Chestnuts	2.000	2.000	1.800										2.000	2.000	1.800									
Germany	Artefacts	0.250	0.100											0.250	0.100										
Germany	Mills and Processors	45.000	19.350											45.000	19.350										
Greece	Dried fruit	4.280	3.081	0.900										4.280	3.081	0.450									
Greece	Mills and Processors	23.000	16.000	1.340										23.000	15.445	1.340									
Greece	Rice and legumes		2.355												2.355										

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ireland	Mills		0.888	0.611											0.888										
Israel	Artefacts	0.650	0.650	0.600										0.650	0.6500										
Israel	Dates (post harvest)	3.444	3.444	2.200	1.800	2.100								3.444	2.755	2.200	1.800	2.100	1.040						
Israel	Flour mills (machinery & storage)	2.140	1.490	1.490	0.800	0.300								2.140	1.490	1.040	0.312	0.300							
Israel	Furniture–imported	1.4220	1.4220	2.0420										1.4220	0										
Italy	Artefacts	5.500	5.500	5.000										5.225	0	5.000									
Italy	Mills and Processors	160.000	130.000	25.000										160.000	65.000	25.000									
Japan	Chestnuts	7.100	6.500	6.500	6.300	5.800	5.400	5.350	3.489	3.317				7.100	6.800	6.500	6.300	5.800	5.400	5.350	3.489				
Latvia	Grains		2.502												2.502										
Netherlands	Strawberry runners post harvest		0.120	0.120		0.120									0	0.120									
Poland	Medicinal herbs & dried mushrooms as dry commodities	4.000	3.560	1.800	0.500									4.100	3.560	1.800	1.800								
Poland	Coffee, cocoa beans	(a)	2.160	2.000	0.500										2.160	1.420	1.420								
Spain	Rice		50.000												42.065										
Switzerland	Mills & Processors	8.700	7.000											8.700	7.000										
UK	Aircraft			0.165												0.165									
UK	Mills and Processors	47.130	10.195	4.509										47.130	10.195	4.509									
UK	Cereal processing plants		8.131	3.480					(a)						8.131										
UK	Cheese stores	1.640	1.248	1.248										1.640	1.248	1.248									

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
UK	Dried commodities (rice, fruits and nuts) Whitworths	2.400	1.256											2.400	1.256										
UK	Herbs and spices	0.035	0.037	0.030										0.035	0.037										
UK	Mills and Processors (biscuits)	2.525	1.787	0.479										2.525	1.787										
UK	Spices structural equip.	1.728												1.728	0	0.479									
UK	Spices stored	0.030												0.030	0										
UK	Structures buildings (herbs and spices)	3.000	1.872	0.908										3.000	1.872	0.908									
UK	Structures, processors and storage (Whitworths)	1.100	0.880	0.257										1.100	0.880	0.257									
UK	Tobacco equipment	0.523												0.050											
UK	Woven baskets	0.770												0.770											
USA	Dried fruit and nuts (walnuts, pistachios, dried fruit and dates and dried beans)	89.166	87.719	91.299	67.699	58.912	19.242	10.041	2.419	0.822	0.740	0.310		89.166	87.719	78.983	58.921	45.623	19.242	5.000	2.419	0.740	0.740		

Party	Industry	Total CUN MB Quantities												Total CUE Quantities											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
USA	Dry commodities/ structures (cocoa beans)	61.519	61.519	64.028	52.256	51.002								61.519	55.367	64.082	53.188								
USA	Dry commodities/ structures (processed foods, herbs and spices, dried milk and cheese processing facilities) NPMA	83.344	83.344	85.801	72.693	66.777	37.778	17.365	0.200					83.344	69.118	82.771	69.208	54.606	37.778	17.365					
USA	Smokehouse hams (Dry cure pork products) (building and product)	136.304	135.742	40.854	19.669	19.699	4.465	3.730	3.730	3.730	3.730	3.730	3.240	67.907	81.708	18.998	19.699	18.998	4.465	3.730	3.730	3.730	3.730	3.730	3.240
USA	Mills and Processors	536.328	505.982	401.889	362.952	291.418	173.023	135.299	74.51	25.334	22.800			483.000	461.758	401.889	348.237	291.418	173.023	135.299	74.510	22.800	**22.800**		
USA	Research								0.159	0.159															