RENOMINATION OF METHYL BROMIDE CRITICAL USE FOR PREPLANT SOIL USE, STRUCTURES, COMMODITIES OR OBJECTS

NOMINATING PARTY: Australia (AUS02 CUN22 Soil Strawberry Runners)

BRIEF DESCRIPTIVE TITLE OF NOMINATION:
Re-application by the strawberry runner industry of Victoria, Australia, for critical use exemption in 2022 from the phase-out of methyl bromide.

NOMINATING PARTY CONTACT DETAILS:

Contact Person:	Patrick McInerney
Title:	Director, International Ozone Protection and Synthetic Greenhouse Gas Section
Address:	Department of the Environment and Energy GPO Box 787 CANBERRA ACT 2601 AUSTRALIA
Telephone:	+ 61 – 2 – 6274 1035
E-mail:	patrick.mcinerney@environment.gov.au

Following the requirements of Decision IX/6 paragraph (a)(1) the Australian nominating authority, the Department of the Environment and Energy, has determined that the specific use detailed in this Critical Use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption.
Yes

Patrick McInerney
Director, International Ozone Protection and Synthetic Greenhouse Gas Section
Department of the Environment and Energy
Date: 24 January 2020

CONTACT OR EXPERT(S) FOR FURTHER TECHNICAL DETAILS

Contact/Expert Person:	Patrick McInerney
Title:	Director, International Ozone Protection and Synthetic Greenhouse Gas Section
Address:	Department of the Environment and Energy GPO Box 787 CANBERRA ACT 2601 AUSTRALIA
Telephone:	+61 – 2 – 6274 1035
E-mail:	patrick.mcinerney@environment.gov.au

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

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

1. PAPER DOCUMENTS: Title of paper documents and appendices	**No. of pages**	**Date sent to Ozone Secretariat**
2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS:	**No. of kilobytes**	**Date sent to Ozone Secretariat**
[A33] Strawberry Runners Operational Procedure, Toolangi Certified Strawberry Runner Growers Co-operative *Biosecurity Tasmania 2019.*	952	24 Jan 2020
[A34] Exemption of Prescribed Matter from Import Conditions and Restrictions, Plant Quarantine Act 1997 Section 99. *Department of Primary Industries, Parks, Water and Environment, Tasmanian Government 2019.*	160	24 Jan 2020

Part A: SUMMARY

1. NOMINATING PARTY: AUSTRALIA

2. NAME AS PER NAMING CONVENTION (Section 3.5.2 of this Handbook)

AUS02 CUN22 Soil Certified Strawberry Runners.

3. BRIEF DESCRIPTIVE TITLE OF NOMINATION:

Re-application by the strawberry runner industry of Victoria, Australia, for critical use exemption in 2022 from the phase-out of methyl bromide (MB).

4. SOIL SITUATION OR STRUCTURE, COMMODITY OR OBJECT TREATED:

Soil fumigation for the production of Certified strawberry runners in Victoria, Australia.

5. QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION:

2022 – 28.98 tonnes.

The Australian government will only approve the requested amount of MB if substitutes are not available for use in 2022. No allocation will be approved if substitutes become available in sufficient time for use in 2022.

6. SUMMARY OF ANY SIGNIFICANT CHANGES SINCE SUBMISSION OF PREVIOUS NOMINATIONS:

This nomination is being submitted collaterally with an application to the Australian Pesticides and Veterinary Medicines Authority (APVMA) for approval to use methyl iodide (MI) as a substitute for MB. A decision on this application is anticipated in the first half of 2021.

The 28.98 tonnes of MB sought in this nomination is for soil disinfestation in the Victorian strawberry runner industry at Toolangi in 2022. The nomination is made under Decision IX/6 because there are currently 'no technically and economically feasible alternatives or substitutes available to the user'. However, there will be no requirement for either any MB or the full amount nominated if research trials with substitutes and/or registration of MI prove successful. The Australian government will only approve the full amount of MB nominated if required. This approach is consistent with the transition schedule for MB originally proposed in AUS02 CUN20 (see Part B of this nomination).

Continued research on improving pathogen control with substitutes at greater soil depths, together with the possible registration of MI/Pic, form the industry's strategy for transitioning away from MB/Pic, which is anticipated between 2021 and 2022.

Extensive research at Toolangi proves that mixtures of MI/Pic control soil-borne pathogens as effectively as MB/Pic. Following recent developments with this product, the chemical industry has commenced the process of registering MI/Pic for use in strawberry runners in Australia. At the time of writing this nomination, the registrant anticipates a decision by the APVMA on the approval of MI in the first half of 2021. If approved, the phase-out of MB with MI in 2021 or 2022 is a realistic prospect for the runner industry. APVMA approval, however, is an independent process and there are no guarantees of completion within expected timelines or on the outcome of the application. For this reason, industry must apply for a CUN in 2022 to ensure continuity of production of runners and their supply to strawberry fruit growers throughout Australia. This is particularly so, given the recent import restrictions placed on runners from Victoria by the state government of Tasmania [A33, A34]. These restrictions mandate the use of MB/Pic for soil disinfestation as a precautionary measure against the regulated pests, potato cyst nematode (PCN) (*Globodera rostochiensis*) and phylloxera (*Daktulosphaira vitifoliae*).

The Australian strawberry runner industry is funding a comprehensive research, development and extension (RD&E) program to develop substitutes for soil fumigation with MB, and this program has made considerable progress despite challenging soil conditions in the runner production area. Recent results continue to show that control of pathogens at greater soil depths is inadequate with the most promising substitutes (viz. ethanedinitrile (EDN), EDN + chloropicrin (Pic), Pic, TF-80® (80% Pic:20% 1,3-dichloropropene (1,3-D)) and microwave), and that further research on these methods is required in 2020 and 2021. Current trials are investigating the use of much higher rates of EDN (up to 1000 kg/ha), application timing of TF-80®, longer treatments times and wavelengths of microwave, and different rates and formulations of MI/Pic for control of *Macrophomina phaseolina* (cause of charcoal rot of strawberry). Further research is necessary for the Victorian Strawberry Industry Certification Authority (VSICA) and the runner industry to have confidence in the effectiveness of substitute treatments (except MI/Pic) in controlling soil-borne pathogens in runner crops, and to meet Certification standards. This is required to meet the organisations' legal responsibilities for due diligence and care, and to minimise the risk of litigation. Litigation is a real and on-going risk to VSICA and the runner industry in Australia (see below for details).

Progress of the RD&E program and new research

RD&E has resulted in soil-less technologies for the economic production of runners of Mother stock (third generation in the Certification Scheme) and an associated reduced use of MB from 2019. However, a revised partial-budget analysis shows that production of Certified runners (fourth generation) using soil-less technologies is still not economically or technically feasible (see Part E 16). The high costs of soil-less systems for production of Certified runners relate to labour, infrastructure (protected structures) and transport requirements. Previous research showed that outdoor production of runner tips using hydroponics was not technically or economically feasible because yields were significantly lower than in protected systems (Milinkovic et al., 2017). Results from recent research showed that commercial soil-less substrate from accredited sources can contain significant concentrations of soil-borne pathogens, including *M. phaseolina* (see Appendix I). For this reason, VSICA does not currently allow Certification of plug plants unless the substrate used

in their production has been disinfested. Analysis is underway to identify and evaluate other substitutes to MB for disinfesting soil-less substrates, such as steam, EDN, microwave, and MI (note: MI has not been evaluated as a hot-gas treatment for disinfestation of bags of soil-less substrate).

Results from recent research also showed that substitute fumigants (viz. Pic, TF-80®, EDN and EDN + Pic) do not provide sufficient control of soil-borne pathogens for production of Certified runners (Appendix I). The latest research findings indicate that the use of slightly higher application rates, barrier films (totally impermeable film), deeper injection, and/or co-application of fumigants has not increased control of pathogens using key substitute fumigants (Appendix I), and other strategies for use of these chemicals are required. Therefore, given these results, VSICA does not currently allow the use of substitute fumigants under the rules of the Certification Scheme. Consequently, any runners grown in soil treated with substitute fumigants are unmarketable, and this would result in a complete economic loss to growers using these treatments.

In 2019, a second prototype rig (Figure 1a) was designed and constructed, and is being tested, to apply substitute fumigants at greater depths in the soils at Toolangi. The previous design (Figure 1b) included small duck-foot tynes, but these did not prove robust in the clay soil types at Toolangi, and did not consistently apply fumigants at greater depths. The improved design includes straight, swept-back tynes that have more consistently applied fumigants at greater depths (Figure 1a). Hot-glue systems on the new rig have not yet proven successful for joining totally impermeable films (TIFs) under the conditions at Toolangi. Further research is planned in 2020 to evaluate the use of TIFs with perforated LDPE edges to improve the strength of traditional glue welds. Also in 2019, the APVMA granted trial permits to evaluate EDN at much higher application rates (up to 1000 kg/ha) than on the current label (500 kg/ha). Current trials are evaluating the application of substitute fumigants (TF-80®, EDN and EDN + Pic) at greater depths with the new rig, and higher application rates of EDN (700, 850, and 1000 kg/ha), on pathogen and weed control in the runner industry at Toolangi, compared with the standard application of MB/Pic. Results from the trials will be available in October 2020.

Trials are also continuing on the use of microwave for soil disinfestation. Current trials are evaluating the use of longer exposure times and longer wavelengths of microwave on control of soil-borne pathogens at greater soil depths. Results from recently published research in the project showed that treatment with microwave alters the structure of microbial communities in soil to the benefit of crop growth (Khan et al., 2019). This follows previous analysis showing the potential for microwave to reduce populations of pathogens and weeds at shallow depths in soil at Toolangi, and the favourable economics of its use compared with steam and chemical fumigants (AUS02 CUN19 [A32]).

Mixtures of methyl iodide (MI) and chloropicrin (Pic) have previously been shown to consistently control soil-borne pathogens as effectively as MB/Pic in runner trials at Toolangi. Registration of MI/Pic for soil disinfestation has recommenced in Australia (see below). Completed and on-going trials are evaluating the effectiveness of MI/Pic for control

of *M. phaseolina* and on accumulation of iodine species in soil, which is required to support the environmental safety and registration of the product.

Developments with methyl iodide

Extensive RD&E in the runner industry at Toolangi, Victoria between 2006 and 2012 proved that soil disinfestation with MI/Pic: (1) controls soil-borne pathogens as effectively as MB/Pic, including at greater soil depths, (2) controls weeds as effectively as MB/Pic, and (3) produces equivalent runner yields to MB/Pic in commercial trials conducted over five consecutive years (AUS 02 CUN14, CUN15). Based on this research, the runner industry's original transition plan away from MB was to adopt MI/Pic following its registration and commercialisation (AUS 02 CUN13, CUN14). This plan collapsed in 2012 when Arysta LifeSciences withdrew its application to register MI in Australia and other countries around the world. In Australia, registration of MI was close to approval when the product was withdrawn and, unlike in the USA, commercial trials with MI/Pic were well advanced and there was strong demand for the product by industry.

In 2019, the runner industry completed an investigation on the feasibility of registering MI in Australia. This included a pre-application assistance (PAA) meeting and assessment by the APVMA on the possible registration of MI in Australia. The assessment identified further research and information that the APVMA required for the evaluation of MI. The APVMA also indicated that the runner industry could not be the registrant for MI in Australia. Subsequently, a chemical company took responsibility for the registration of MI in Australia. The registrant has identified an overseas manufacturer of MI and supply chain options. The manufacturer has completed five-batch chemical analyses of the product for approval by the APVMA. The registrant has engaged experienced consultants to manage the registration of MI, including the former head of Arysta LifeSciences in Australia.

Recent research shows that iodine species do not accumulate to phytotoxic levels in soils from Toolangi following fumigation with MI or MI/Pic (see Appendix I). This is important new data that the APVMA sought to assess the environmental safety of MI. Recent results also showed that formulations containing 30% MI and 70% Pic are the most effective for controlling *M. phaseolina* in soil and in buried infected crowns. This data will support a label application for the use of MI/Pic for control of *M. phaseolina*. This is important because there is nil tolerance for this pathogen under the rules of the Victorian Strawberry Runner Scheme (i.e. detection of this pathogen in a runner crop means that the entire crop cannot be Certified).

Provided all further data and research can be completed in a timely manner, the APVMA and the registrant estimate that a decision on the technical assessment of MI could occur by the first half of 2021. Industry is anticipating registration of MI by 2021 and full commercial use by 2022, but this is subject to the independent processes of the APVMA.

On-going risk of litigation

Economic issues associated with the risk of litigation cannot be ignored in relation to decisions and adoption of substitutes to MB. The potential dissemination of soil-borne pathogens and pests in runners or in soil on runners to strawberry fruit growers around Australia is a proven litigation risk to the runner industry and VSICA. In addition, the Australian state of Tasmania has implemented import conditions for strawberry runners from Victoria that mandate the use of MB/Pic for soil disinfestation [A33, A34].

From 2004-2015, the integrity and credibility of the Certification Scheme and the production processes that it mandates were challenged in a legal case against the Victorian runner industry. The plaintiff alleged that the soil-borne pathogen, *Rhizoctonia fragariae*, was carried from Victoria to South Australia into their fruiting fields in or on Certified runners produced through the Scheme. The case took 10 years before reaching court, and the court proceedings took approximately 6 months. Judgement was ultimately in favour of the runner industry and vindicated the integrity of the Certification Scheme. However, the case cost the runner industry approximately AU$1.5M and the plaintiff an estimated AU$1M. If judgement was in favour of the plaintiff it was expected that costs to the runner industry following further legal challenges would have totalled more than AU$4M. This would have forced the closure of the Victorian runner industry, and possibly the Australian fruit industry valued at AU$450M p.a.

During the court case, national and international expert witnesses provided strong evidence to support the use of MB/Pic for soil disinfestation in the Certification Scheme. This was based on peer reviewed research published in international journals. The court found that soils were properly disinfested using MB/Pic (50:50) at 500 kg/ha in the runner industry in accordance with the rules of the Certification Scheme. The use of MB/Pic in the runner industry strongly supported the court's final decision in the case.

In late 2018, the runner industry was issued a Summons for an alleged breach of the Tasmanian *Plant Quarantine Act (1997)* relating to the alleged movement of contaminated soil on runners from Victoria to Tasmania, and therefore soil-borne pathogens. After a preliminary hearing in 2019, the court adjourned the case until 2020. A key defence in this case is the substantial evidence that fumigation with MB/Pic reduces the risk to negligible levels of soil being contaminated with pathogens and pests. Current research so far demonstrates that substitute fumigants do not control pathogens in soils at Toolangi to equivalent levels as MB/Pic. Therefore, the premature adoption of substitute fumigants would not only increase the risk of pathogens in soil on runners, but also increase the risk of litigation against the runner industry. Based on this evidence, the Tasmanian government issued import regulation for runners from Victoria that mandate the use of MB/Pic for soil disinfestation [A33, A34]. The perceived risk is that soil on runners may contain the regulated pests, phylloxera and potato cyst nematode. Strawberry is not a host of these pests, but areas adjacent to Toolangi have crops and soils that are infested with these organisms. This reflects the need for on-going research to identify substitutes that not only control pathogens of strawberry to equivalent levels as MB/Pic, but also regulated pests of other crops.

The threat of litigation is a reality in Australia for nursery schemes that produce Certified plants. Currently, a move away from MB/Pic in the runner industry would significantly increase this risk. This is because research conducted at Toolangi, Victoria shows that substitute fumigants tested do not control soil-borne pathogens as effectively as MB/Pic (except for MI/Pic). Moreover, recent research from Europe shows that lethal soil-borne pathogens such as *M. phaseolina* and *Phytophthora* spp. are prevalent in Spanish strawberry nurseries that have transitioned away from MB/Pic, and that infected runners are a potential source of infection in fruit growing regions (Pastrana et al., 2017). In view of the potential consequences of dissemination of pathogens via the Certification Scheme on strawberry fruit production in Australia, including the risk of litigation, the Board of VSICA needs scientific evidence that substitute treatments for MB are as effective as MB/Pic in controlling soil-borne pathogens. VSICA requires two years of data proving a substitute is as efficacious as MB/Pic before changes to rules of the Certification Scheme can be made (note: there is already sufficient data on MI/Pic to meet this requirement). This is essential to demonstrate appropriate governance and best practice in any future litigation cases, but also to protect strawberry fruit growers from significant economic losses due to diseases introduced onto their farms via planting material.

Increased importance of containing charcoal rot and other soil-borne diseases

Evidence from the Australian strawberry fruit sector and international runner industries shows that the premature phase-out of MB can lead to new diseases or the increased occurrence of previously obscure diseases that can devastate commercial production. It is vitally important that the Victorian runner industry adopts alternatives based on good science and product efficacy. Otherwise, soil-borne pathogens could propagate in runners, and disseminate to fruit growing regions and destroy the strawberry fruit industry in Australia.

Macrophomina phaseolina and *Fusarium oxysporum* f.sp. *fragariae* are significant soil-borne pathogens of strawberry crops, causing wilt diseases and plant deaths. Prior to 2006, these pathogens were well controlled in the strawberry fruit industry by MB/Pic-fumigation. By 2014, serious disease outbreaks caused by *M. phaseolina* and *Fusarium* spp. occurred in the strawberry fruit industry in southern Victoria and on the Sunshine Coast in Queensland [AUS02 CUN17 A22, A23]. In Western Australia, the incidence of Fusarium wilt in strawberries has steadily increased since the phase-out of MB (https://www.agric.wa.gov.au/strawberries/crown-and-root-rot-diseases-strawberries). In 2019, the pathogen *Neopestalotiopsis rosae* was identified in wilting strawberry plants with crown rot symptoms in Western Australia and Queensland. A paper is being finalised to report this soil-borne fungus as a new pathogen and disease of strawberry. The disease appears similar to a new crown rot disease of strawberry in Europe caused by *Pestalotiopsis longisetula* (Van Hemelrijck et al., 2017).

An extensive survey was conducted in the strawberry fruit and nursery industries in Victoria during 2017 [AUS02 CUN20 A30]. Soil and strawberry plant samples were taken from 211 sites across 106 farms (94% of strawberry farms in Victoria). Soils at 75% of the sites sampled in the fruit industry were fumigated with Pic, 1,3-D/Pic or metham sodium (MS), whilst soils at 15% of sites were not fumigated. Soils sampled in the nursery industry (10% of all sites sampled) were treated with MB/Pic under a CUE. Results showed that *M. phaseolina* was present in soil or plants at 80% of fruit farms, in all districts in Victoria. This

represents an exponential increase in the incidence of charcoal rot in strawberry plants at farms in Victoria, since previous surveys. The average incidence of charcoal rot in plants in the strawberry fruit industry in Victoria was 18%. *M. phaseolina* was not detected, however, in soil or in plants in the nursery industry, where MB/Pic is still used. *M. phaseolina* was present, however, in strawberry plants on fruit farms just 10 km from the Toolangi Plant Protection District (where Certified strawberry runners are grown).

Currently, MB/Pic is the only fumigant (except MI/Pic) proven to eradicate *M. phaseolina* in infected strawberry debris in soil in Australia (Hutton et al., 2013). In Europe where MB/Pic is phased-out, Pastrana et al. (2017) showed that 47% soils treated with substitute fumigants in strawberry nurseries in Spain contained *M. phaseolina*. They concluded that '*ineffectively fumigated soils in nurseries…, along with infected runner plants, can be inoculum sources of soilborne strawberry pathogens in Spain*'. Similar outbreaks of crown rots caused by *Macrocphomina* and *Fusarium* spp. have occurred in strawberries in other regions of the world where MB has been phased-out (e.g. Avilés et al., 2008; Zveibil et al., 2012; Koike et al., 2013). Recent research shows that no strawberry cultivar is immune to charcoal rot, with the key cultivars grown in Australia (e.g. Red Rhapsody, Cabrillo, Albion, San Andreas, Florida Festival,) being tolerant or moderately susceptible to the disease (Sanchez et al., 2016; Mansouripour et al., 2018; Gomez et al., 2020).

The continued critical-use of MB in the Victorian strawberry runner industry is considered more important than ever, until new treatments (e.g. MI/Pic) are developed that can control *M. phaseolina* and *F. oxysporum* to equivalent levels as MB/Pic. This is because *M. phaseolina* outbreaks in the strawberry fruit industry are so close to the area where strawberry runners are produced, and the potential for the pathogen to be introduced into runner crops via soil attached to vehicles, wind-blown dust etc. A national research project is underway to identify better fumigant, cultural and hygiene practices for managing charcoal rot, including an evaluation of MI/Pic. Early results from the project were published in the proceedings of the most recent MBAO conference (McFarlane et al., 2019a; McFarlane et al., 2019b; Gomez et al., 2019). Results proved that: (1) infested crowns in soil are an inoculum source for charcoal rot, (2) it is difficult to eradicate inoculum of *M. phaseolina* in infested crowns in the soil with substitute fumigants, (3) the use of TIF can improve the effectiveness of some substitute fumigants for control of *M. phaseolina*, and (4) the Australian strawberry industry is adopting improved practices of farm biosecurity to minimise the spread of *M. phaseolina* and charcoal rot.