

Part A: SUMMARY

1. NOMINATING PARTY: AUSTRALIA

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

AUS02 CUN23 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 2023 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:

2023 – 14.49 tonnes.

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

This nomination is being submitted in conjunction with an application by Salutterra Pty Ltd to the Australian Pesticides and Veterinary Medicines Authority (APVMA) for approval to use methyl iodide (MI) as a fumigant for soil disinfestation in strawberry runners (<https://apvma.gov.au/application-summaries/2020/2020-08#as-next-step>). The APVMA has approved the preliminary assessment of MI and set a date of 17 January 2022 for a decision on the application [A35]. If the application is approved on this date it will allow a 50% reduction in MB use in 2023 in line with the revised transition strategy (Table 1) and ensure continuity of runner production. However, approval of MI by the APVMA on 17 January 2022 would not allow sufficient time for supply of the chemical and training of fumigators in its safe handling and application for the 2022 fumigation season (see Part B).

The 14.49 tonnes of MB sought in this nomination is for soil disinfestation in the Victorian strawberry runner industry at Toolangi in 2023. The nomination is made under Decision IX/6 because there are currently 'no technically and economically feasible alternatives or substitutes available to the user'. This approach is consistent with the transition schedule for MB originally proposed in AUS02 CUN20 and adjusted in light of APMVA timelines (see Part B).

The Australian strawberry runner industry continues to fund 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, and in 2020, with COVID-19 restrictions. Recent results continue to show that control of pathogens at greater soil depths is inadequate with the most promising, registered substitutes (i.e., ethanedinitrile (EDN), EDN + chloropicrin (Pic), TF-80® (80% Pic:20% 1,3-dichloropropene (1,3-D)) and microwave), irrespective of application depth and rate, and the use of TIF (Appendix I). Therefore, further research is necessary in 2021 and 2022 for the Victorian Strawberry Industry Certification Authority (VSICA) and the runner industry to have confidence in the effectiveness of substitute treatments, except for MI/Pic, for control of 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.

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 phasing out MB/Pic, which is anticipated by the end of 2023 (based on the APVMA's latest date for a decision on the registration of MI).

Developments with methyl iodide

Extensive RD&E in the runner industry at Toolangi, Victoria between 2006 and 2012 proved that soil disinfection 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). However, in 2012 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 commercial trials with MI/Pic were well advanced.

In 2019, the runner industry completed an investigation on the feasibility of registering MI in Australia. This included a pre-application assistance 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, and that a chemical registrant for MI was required. Subsequently, Salutterra Pty Ltd took responsibility for the registration of MI in Australia and has identified an overseas manufacturer of MI and supply chain options. The registration application passed preliminary assessment by the APVMA on 20 August 2020 [A35] and the registrant submitted a draft label to the APVMA [A36]. The APVMA has set a date of 17 January 2022 for a decision on the application.

In 2020, VSICA engaged an independent consultant to review the data on the efficacy of MI/Pic for soil disinfection and production of strawberry runners. The consultant concluded:

'Considerable R&D has clearly demonstrated that MI/Pic (30:70 at 500kg/ha) is as efficacious as MB/Pic (50:50 at 500kg/ha) in controlling weeds and the major pathogens of strawberry runners at Toolangi. If efforts to register MI for use in Australia are successful, the Board of VSICA can have confidence that MI/Pic is a suitable replacement for MB/Pic for the production of Certified runners. Under these circumstances, the Board

will meet its due care and diligence responsibilities if it changes the rules of the Certification Scheme to require fumigation of soil with MI/Pic instead of MB/Pic.'

Subsequently, the Board of VSICA decided to accept the use of MI/Pic for soil disinfestation into the rules of Certification Scheme for runner production as soon as its registration is approved by the APVMA.

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, 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. Recent research showed that commercial soil-less substrate from accredited sources can contain significant concentrations of soil-borne pathogens, including *M. phaseolina* (AUS02 CUN22). 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.

Results from recent research also showed that substitute fumigants (viz. 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 much higher application rates (double label 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. They also showed that the poor runner yields in soils treated with EDN are related to ammonium toxicity, which concurs with research by Stevens et al. (2020b) in Florida. Therefore, given these results, VSICA does not currently allow the use of substitute fumigants under the rules of the Certification Scheme. New research is evaluating different application times of substitute fumigants and planting times of strawberry runners to minimise re-colonisation of soils by pathogens. Trials are also investigating a hot-melt system for joining TIF film when applying substitute fumigants (Figure 1).

Trials are continuing on the use of microwave for soil disinfestation. Recent results showed that microwave does not control pathogens adequately at greater soil depths. New trials are evaluating the effect of larger, commercial units with greater power (5 kW) than previous models (2 kW) (Figure 2). Further trials are also planned that will evaluate the use of longer exposure times and wavelengths of microwave on control of soil-borne pathogens at greater soil depths.

On-going risk of litigation

The potential dissemination of soil-borne pathogens and pests in runners or in soil on runners to strawberry fruit growers around Australia is a litigation risk to the runner industry and VSICA. For example, in a long legal case (2004-2015) costing more than AU\$2.5 M, a

strawberry grower 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 (see AUS02 CUN22 for details). 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, based on published research. Judgement was ultimately in favour of the runner industry and vindicated the integrity of the Certification Scheme. The use of MB/Pic in the runner industry strongly supported the court's final decision in the case.

Again, 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. A key defence in the case is the substantial evidence that fumigation with MB/Pic reduces the risk to negligible levels of soil being contaminated with pathogens and pests. Based on this evidence, the Tasmanian government issued import regulations in 2019 for runners from Victoria that mandate the use of MB/Pic for soil disinfestation [AUS02 CUN22 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. In 2020, the court agreed to adjourn the case indefinitely provided the runner industry fully comply the new export regulations, including the use of MB/Pic and annual testing for regulated pests. This highlights 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 and its economic impact are 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 because registered substitutes do not effectively control soil-borne pathogens. 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 and the risk of litigation, the Board of VSICA needs scientific evidence that substitute treatments are as effective as MB/Pic in controlling soil-borne pathogens. VSICA requires two years of data proving a substitute is as effective as MB/Pic before changes to rules of the Certification Scheme can be made (note: MI/Pic meets this requirement and has been accepted into the Scheme).

Increased importance of containing new and emerging 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 therefore important that the Victorian runner industry adopts alternatives based on good science and product efficacy.

Macrophomina phaseolina and *Fusarium oxysporum* f.sp. *fragariae* are significant soil-borne pathogens of strawberry crops, causing wilt diseases and plant deaths (Figure 3a). 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]. A survey in 2020 showed that more than 95% of strawberry fruit farms are now infected with *M. phaseolina*, including farms only 6 km from Toolangi. However, it was not detected in soil or in plants in the nursery industry at Toolangi, where MB/Pic is still used.

Currently, MB/Pic is the only registered fumigant 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*. Similar outbreaks of crown rots caused by *Macrophomina* 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 grown in the runner industry is immune to charcoal rot, with the new 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).

In 2019, a new soil-borne pathogen *Neopestalotiopsis rosae* was identified in wilting strawberry plants with crown rot symptoms in Western Australia and Queensland (Figure 3b). It is related to a new pathogen of strawberry *Pestalotiopsis longisetula* that appeared in regions in the northern hemisphere where MB was phased out (Van Hemelrijck et al., 2017). Similarly, in 2020, a new disorder called ‘Red Leaf’ has emerged in strawberry in Australia, including in the Queensland nurseries that no longer use MB. Grower surveys showed that 12% of plants in Queensland are dying due to the disorder and early research has pointed to a new soil-borne *Cladosporium* sp. as the cause. These new soil-borne pathogens have not appeared in strawberries at Toolangi that currently use MB/Pic for soil disinfestation.

Continued access to MB in the Victorian strawberry runner industry is considered more important than ever, until MI/Pic is registered, or other substitutes developed that can control *M. phaseolina*, *F. oxysporum* and new soil-borne pathogens 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 nearing completion to identify better fumigant, cultural and hygiene practices for managing charcoal rot, including an evaluation of MI/Pic (McFarlane et al., 2019a; McFarlane et al., 2019b; Gomez et al., 2019). Interim 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* but not eradicate it, and (4) the Australian strawberry industry is adopting improved practices of farm biosecurity to minimise the spread of *M. phaseolina* and charcoal rot.