

Part A: SUMMARY

1. NOMINATING PARTY: AUSTRALIA

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

AUS02 CUN20 Soil Strawberry Runners

3. BRIEF DESCRIPTIVE TITLE OF NOMINATION:

Re-application by the strawberry runner industry of Victoria, Australia, for critical use exemption in 2020 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:

2020 – 28.98 tonnes

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

This nomination is for 28.98 tonnes of methyl bromide (MB) for soil disinfestation in the Victorian strawberry runner industry at Toolangi in 2020. The nomination is made under Decision IX/6 because there are ‘no technically and economically feasible alternatives or substitutes available to the user’.

The Australian strawberry runner industry has commissioned a comprehensive research and development (R&D) 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 indicate that control of pathogens at greater soil depths is still not adequate, and that further R&D is required in 2019 and 2020. This is necessary for the Victorian Strawberry Industry Certification Authority (VSICA) and the runner industry to have confidence in the efficacy of substitute treatments in controlling soil-borne pathogens in runner crops to be certified, and hence, to meet their due diligence and care responsibilities and minimise the risk of litigation.

As an additional strategy to phase out the use of MB in 2021 the runner industry has seized the opportunity created by recent developments with the fumigant methyl iodide (MI), and is well placed to progress the registration of MI in Australia for use in the production of strawberry runner crops.

Progress of the R&D program and future plans

Recent R&D has resulted in soil-less technologies for the economic production of runners of mother stock (third generation in the Certification Scheme) without the use of MB from 2019. However, production of certified runners (fourth generation) using soil-less technologies is not economically or technically feasible. Furthermore, registered substitute fumigants (e.g. chloropicrin (Pic) and 1,3-dichloropropene (1,3-D)/Pic) for MB are not providing sufficient control of soil-borne pathogens for production of certified runners [A30]. The latest research findings indicate that the use of higher application rates, barrier films (TIF), deeper injection, and integration with biofumigant crops has not increased control of pathogens using key substitute fumigants (i.e. 1,3-D/Pic 20:80) (Appendix 1), and other strategies for use of these chemicals are required. Therefore, given these results, the Victorian Strawberry Industry Certification Authority (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.

R&D has commenced to evaluate the economic and technical feasibility of using steam and microwave for soil disinfestation, and trials with different fumigant combinations (e.g. ethanedinitrile and Pic, and recaptured MB from quarantine applications) that may ultimately control soil-borne pathogens more effectively than other substitutes.

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, Victoria. However, Arysta LifeSciences withdrew its application to register MI in Australia and other countries in 2012, just before its anticipated approval by the Australian Pesticides and Veterinary Medicines Authority (APVMA). There have been some new developments in relation to MI (see below), and it has re-emerged as a real possibility for registration and adoption for control of soil-borne pathogens and weeds of runner crops.

The runner industry's plan to transition away from MB in 2021 is therefore based on improving the efficacy of substitute fumigants for controlling pathogens at greater soil depths in trials in 2019 and 2020, and/or gaining registration and adoption of MI/Pic.

Developments with methyl iodide

Extensive R&D 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, (3) produces equivalent runner yields to MB/Pic in commercial trials conducted over five consecutive years, and (4) has no significant bystander or environmental health issues when used according to the proposed label (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 US, commercial trials with MI/Pic were well advanced and there was strong demand for the product by industry.

One of the reasons for the withdrawal of the registration application was the price of iodine, affecting the economics of the manufacture of MI. The price of iodine has fallen dramatically since 2012 (<https://minerals.usgs.gov/minerals/pubs/commodity/iodine/mcs-2017-iodin.pdf>), and this makes the importation of MI to Australia an even better prospect. The runner industry has investigated the possibility of becoming the registrant for MI in Australia. It has engaged a registration consultant, who has identified several potential manufacturers and suppliers of MI. The industry also sought and gained permission from Arysta LifeSciences to use all its previous registration data and applications for MI. This is a very significant step because the registration process for MI was well advanced in Australia in 2012, and all research was completed for the APVMA to decide on its approval for use. Currently, industry has lodged an application to the APVMA to review all previous data and reports on MI and advise on what, if any, additional data is required to progress registration in Australia. In addition, the Board of VSICA will review data on MI/Pic in 2018 to decide on its acceptability for use as a pre-plant soil treatment for the Certification Scheme. Industry is aiming to achieve registration of MI by 2021, but this is subject to the independent processes of the APVMA.

Risk of litigation

The potential dissemination of soil-borne pathogens in runners or in soil on runners to strawberry fruit growers around Australia is a proven litigation risk to the runner industry and VSICA.

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 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 A\$1.5M and the plaintiff an estimated A\$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 A\$4M. This would have forced the closure of the Victorian runner industry, and possibly the Australian fruit industry valued at \$420M 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.

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 (with the exception of MI/Pic). Moreover, recent research from Europe shows that lethal soil-borne pathogens such as *Macrophomina 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 efficacious as MB/Pic in controlling soil-borne pathogens. The Board requires two years of data proving a substitute is as efficacious as MB/Pic before changes to rules of the Scheme can be made. This is essential to demonstrate appropriate governance and best practice of the Board in any future litigation cases.

Increased importance of charcoal rot in the Victorian strawberry fruit industry and international runner industries that have phased-out MB

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 *Macrophomina* 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>).

An extensive survey was conducted in the strawberry fruit and nursery industries in Victoria during 2017 [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 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 *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 is resistant to charcoal rot, with the key cultivars grown in Australia (e.g. Albion) being moderately susceptible (Holmes et al., 2017).

The continued critical-use of MB in the Victorian strawberry runner industry is considered more important than ever, until new treatments are developed that can control *M. phaseolina* and *F. oxysporum* to equivalent levels as MB/Pic. This is because *Macrophomina* 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 etc. A new research project has commenced in Australia to identify better fumigant and cultural practices for managing charcoal rot, including an evaluation of MI/Pic (see below).

New research projects

Three new projects have recently been funded and contracted to evaluate suitable substitutes for the runner industry to transition away from MB:

1. *'Evaluation and development of substitutes to methyl bromide for production of Certified runners'*. This research project aims to develop better application techniques for current (e.g. 1,3-D/Pic 20:80) and new fumigants (e.g. EDN + Pic, MI/Pic), and more economic technologies for soil-less production of certified runners. Dr Scott Mattner from VSICA leads the project. The project has provisions for funding from 2017 to 2020, with scope for further extension if required.
2. *'An economic review of microwave and steam soil treatment as a potential substitute for soil fumigation in the strawberry runner industry'*. This project aims to evaluate the economic and environmental viability of microwave and steam treatments as potential substitutes for soil fumigation with MB/Pic and of a substitute fumigant (1,3-D/Pic) in the Victorian runner industry. The results from the project will direct future research investment into microwave or steam for soil disinfestation in the strawberry runner industry at Toolangi, Victoria. Professors Graham Brodie and Alan Davison from the University of Melbourne lead the project. The project is funded from 2017 to 2018.
3. *'Improved management of charcoal rot of strawberry'*. This project aims to develop better fumigant, cultural, and hygiene plans for managing charcoal rot in the national strawberry industry. Dr David Oag from the Queensland Department of Agriculture and Fisheries leads the project and VSICA manages the chemical control component. The project is funded from 2017 to 2020.

These projects demonstrate that AUS02 CUN20 meets the requirements of Decision IX/6 (iii) that a research program is in place and that appropriate effort is being made to transition away from MB.

Infrastructure for production of mother stock

The runner industry has completed construction of screenhouses and established commercial trials of hydroponic systems for production mother stock runners (third generation). Recent research [AUS02 CUN19 A28; A29] and analysis (see Part E 16) indicates that these systems are economically and technically feasible for production of mother stock runners, but not certified runners (the fourth generation in the Certification Scheme). Industry will fully adopt these hydroponics systems for commercial production of mother stock runners from 2019. Although this move will result in a modest reduction in MB use in 2019 and 2020, it is still a

significant step towards final phase-out of MB. This is because growers will have ceased the use of MB in three of the four multiplication generations in the scheme. The move also allows industry to concentrate all its resources and effort to address phase-out of MB in the final generation of runners (see research projects listed above).