Methyl Bromide Critical Use Nomination for pre-plant soil use (open field or protected environment)

Form 1. For both New or continuing nominations (Re-nominations)

NOMINATING PARTY:
CANADA

NAME (AS PER NAMING CONVENTION, Para 3.5.2 of Handbook)
CAN CUN 2022 Strawberry Runners Nomination.doc

BRIEF DESCRIPTIVE TITLE OF NOMINATION:
Methyl bromide as a pre-plant fumigant for soil used to grow strawberry runners on Prince Edward Island (PEI), Canada.

CROP NAME (SPECIFY OPEN FIELD OR PROTECTED):
OPEN FIELD - Westech Agriculture Ltd. (Westech) operates a strawberry plant nursery in PEI growing plants for the export market, primarily the United States of America (USA).

QUANTITY OF METHYL BROMIDE REQUESTED IN THE NOMINATION:
5.017 metric tonnes of pure methyl bromide for the 2022 calendar year, which is the equivalent of 7,488 kg of Terr-O-Gas® (67:33). This represents a reduction of 244 kg of pure methyl bromide or 364 kg of Terr-O-Gas ® (67:33) from the quantity requested in 2021.

It is important to note that while the grower is making significant progress towards the adoption of indoor soilless production for G2 runner tips, they do not expect that indoor production in the existing greenhouse alone will offset the entire proposed reduction for 2022 of 244 kg of methyl bromide. Based on 2020 levels of production described further in the nomination, the majority of the proposed reduction for 2022 will result from fumigating a smaller total acreage across all stages of production, while the grower continues to work to optimize the existing greenhouse structure and operations to increase indoor soilless runner tip production.

SUMMARY OF ANY SIGNIFICANT CHANGES SINCE SUBMISSION OF PREVIOUS NOMINATIONS (IF APPLICABLE):

Research
Since 2017, the grower has been conducting research to trial soilless cultivation using a coconut coir substrate (Botanicoir Precision Plus growbags), in order to determine the viability of adopting this approach in their operation for the commercial production of G2 runner tips. The grower continued this research in 2020, for the first time in an indoor (greenhouse) environment, the results of which are presented below.

If a soilless medium can repeatedly produce quality runner tips, then the grower can consider reducing the use of methyl bromide by adopting this approach. Prior to adopting an alternate growing technique such as a soilless system, trial results must be positive and repeated for at least 2-3 years and prior to phasing in an alternative system following positive trials results, the system must be optimized and proven to be economically viable.

After two seasons (2019 and 2020) of increasingly positive soilless research trials and after completing the construction of a small greenhouse, the grower can now begin to consider phasing in a limited indoor soilless system for G2 runner tip production and therefore begin to reduce the quantity of methyl bromide used for pre-plant fumigation for this stage of production.

As such, Canada has nominated a reduced amount for the 2022 growing season. Canada expects to continue to reduce the quantity nominated over the coming years, as the grower continues to develop expertise and increases their capacity for indoor soilless production, with the optimization of the existing greenhouse structure and future construction of additional greenhouse facilities. However, given the much higher costs associated with indoor soilless production (infrastructure and operating – see Section 24), yields (i.e. revenues) must reliably and significantly exceed that of conventional methods, and/or the grower must find cost savings, in order to be considered economically viable and be fully adopted for the production of G2 runner tips.

Please see Section 16 for more information on the design, implementation and previous results of the soilless research program. Furthermore, soilless research program progress reports from the grower for 2017, 2018, 2019 and 2020 are included as Appendix 1 (*CAN 01.0 CUN 2022 – Soilless Research Program Results for 2017*), Appendix 2 (*CAN 01.1 CUN 2022 – Soilless Research Program Results for 2018*), Appendix 3 (*CAN 01.2 CUN 2022 – Soilless Research Program Results for 2019*) and Appendix 4 (*Can 01.3 CUN 2022 – Soilless Research Program Results for 2020*), respectively. Please note that the information contained in the progress reports on research trials in Appendices 1 – 4 is to remain **confidential**. These reports are not for circulation beyond MBTOC members and should be used for assessing Canada's critical use nomination only.

In 2017, trial results were unsatisfactory due to problems encountered with the irrigation and fertility system. In 2018, trial results were more positive for Chandler and Camarosa varieties at all plant densities; however, ratios of runner-tips to mother plants were below the target of 20:1 for all varieties at all densities.

Results from the 2019 research program were quite positive for the Chandler and Camarosa varieties. The grower harvested soilless runner tips on three occasions in 2019: 8-July 24-August and 20-September. When considering the full harvest data (i.e. the sum of all three harvests), multiplication ratios for the Chandler variety at all densities were higher than the target ratio of 20:1. Furthermore, the lower density treatments for the Camarosa variety also surpassed (21.5:1, 4 stock plants per bag) and approached the target ratio (17.3:1, 6 stock plants per bag). As in 2016, 2017 and 2018, the multiplication ratios in 2019 for the Albion variety were unacceptably low.

It is important to note that the grower typically harvests soil based (i.e. conventional) runner tips in July and late August or early September, during the peak market windows. However, in 2018 and 2019 the grower observed that outdoor soilless plants required an additional 3-4 weeks of growing time, relative to conventional plants, resulting in a late –September harvest for the soilless plants.

At present, the grower has not identified an export market for runner tips harvested in late-September. Without a market for runner tips harvested in late-September, the observed ratios of runner tips per stock plant for the July-August harvests alone are unacceptably low by technical standards (minimum of 20:1) across all varieties and plant densities.

However, if the grower can identify a market for material harvested later in the season or can produce soilless plants indoors, in order to overcome the observed three-week lag in development (and therefore have all soilless harvests occur within the peak market windows), then the ratio of runner tips to stock plants becomes technically acceptable for these varieties.

On PEI, it is not possible to begin the outdoor growing season three weeks earlier. In 2019, the grower erected a small greenhouse (28' x 96' = 2,688 ft^2) to trial the production of soilless plants in an indoor environment, which would allow for an earlier start to the growing season.
For 2020, the grower moved all soilless research trials (all varieties) into the greenhouse. The grower planted 1365 plants in mid-May, which is two-weeks earlier than outdoor soilless planting occurred in 2018 and 2019. Results of the 2020 research trials were quite positive – Table 1 below provides a summary. Refer to attachment *CAN 01.3 CUN 2022 – Soilless Research Program Results for 2020* (Confidential) for additional information regarding 2020 research program and results.

Table 1: Summary of 2020 indoor trial results for Botanicoir Precision Plus growbags.

	Greenhouse					**Field**
Treatment (Variety)	**# of Plants**	**Target Ratio** (Tips / Stock)	**Ratio First Harvest** (Tips / Stock)	**Ratio Second Harvest** (Tips / Stock)	**Ratio Total Harvest** (Tips / Stock)	**Ratio Total Harvest** (Tips / Stock)
Chandler	312	20	12.6	23.2	35.8	25.1
Camarosa	294	20	11.3	21.0	32.3	25.3
Albion	416	20	5.7	2.6	8.3	12.4
Ruby	343	20	7.0	22.0	29.0	22.2

All ratios presented in runner tips per foundation stock plant.

In 2020, the greenhouse production ratios for Chandler, Camarosa and Ruby varieties exceeded the technical feasibility target ratio of 20:1 and exceeded production ratios from the field under conventional planting. While the grower had no experience with indoor production (soilless or conventional) prior to 2020, if they can improve the process, layout and selection of varieties to optimize the production of soilless plants indoors, even higher ratios could be realized. Indeed, improving upon the production ratios achieved indoors during the first season in the greenhouse will be the objective of the 2021 research trials.

In 2020, the 1365 indoor mother plants (sum of all varieties) produced 38,191 G2 runner tips, or an average of 28.7 runner tips per mother plant. In the field, average production in 2020 was 315,384 runner tips per acre, from an average of 13,469 mother plants per acre. This results in an average production ratio of 23.4 runner tips per mother plant for field based production in 2020.

Considering the 2020 total yield for soilless and the average field production in 2020, the grower would require approximately eight times (315,384 runner tips / 38,191 runner tips) the indoor square footage available in the existing greenhouse structure (2,688 ft^2, or 0.0617 acres) to match the production of one acre in the fields. In other words, at the average levels of production achieved in 2020, the grower would require approximately 0.49 acres of indoor greenhouse space to match the average production of one outdoor acre and thus would require approximately 14.7 acres of indoor greenhouse space to replace the entire 30-acre G2 runner tip field at 2020 levels of production.

As such, the grower has identified two significant issues affecting the economic viability of this technical alternative; the much higher material and operating costs of soilless cultivation in general, and the construction, maintenance and operation costs of the greenhouse space required to replace further outdoor acreage (see Section 24).

In 2019, the grower estimated that costs for outdoor soilless cultivation are $12,826 higher per acre (approximately three times greater) than for traditional cultivation using methyl bromide (see Section 24). These additional costs correlate directly to an equal loss in revenue for the grower, given the change to a soilless growing system will not produce higher quality G2 runner tips, and thus the increased costs cannot be passed on to the customer. Therefore, outdoor soilless production must far exceed that of conventional methods, and/or the grower must find significant cost savings for this approach to be economically viable.

Based on 2020 levels of production and expenditures, the grower has calculated that the cost of indoor soilless production per plant ($0.13) is just under double the cost of outdoor soilless production per plant ($0.07), excluding costs associated with construction of the greenhouse (see Section 24). This does not include any cost associated with construction of the greenhouse facility at this point. The capital (construction and setup) costs for the existing greenhouse structure were approximately $52,000 (or $19.34/ft^2); however, the construction of a much larger commercial-scale greenhouse is expected to bring down costs significantly on a per square foot basis.

Again, the grower does not expect the change in growing system to produce higher quality G2 runner tips and thus the increased cost cannot be passed on to the customer. **Therefore, indoor soilless production must be approximately double that of conventional methods in order to be considered economically viable.** If we assume that field-based production is constant year-to-year at approximately 20:1 (mother plants to runner tips), the grower then needs to realize production ratios in the greenhouse of a minimum of 40:1 to be economically viable and higher still when annualized costs associated with greenhouse construction are included.

REASON OR REASONS WHY ALTERNATIVES TO METHYL BROMIDE ARE NOT TECHNICALLY AND ECONOMICALLY FEASIBLE:

1. Chemical Alternatives
Many feasible chemical alternatives to methyl bromide are not federally registered in Canada (e.g. those containing 1,3-D), and as such are not permitted and/or available to the grower. For those chemical alternatives that are federally registered (e.g. chloropicrin, metam sodium and metam potassium), the Government of PEI will not permit their use under the Pesticide Control Act due to concerns related to groundwater contamination. Please refer to Section 15 for more information.

2. Soilless Cultures
Haygrove high tunnel multi-span:
In July 2013, Canada submitted a detailed analysis of the economic feasibility of the Haygrove soilless culture system in PEI, comparing a business as usual scenario with the implementation of

a soilless system involving Haygrove high tunnel multi-span – see Part E and Annex 1. While the study was completed seven years ago, the cost-estimates associated with the Haygrove high tunnel multi-span system and the business-as-usual scenario remain valid.

The analysis clearly shows that a shift to Haygrove soilless cultivation would mean a significant change in production methods and due to significant increased costs would result in near term market disruption for the grower in PEI, while only serving to address methyl bromide used for G1 foundation stock (405kgs). As such, the adoption of a Haygrove soilless culture system for foundation stock production in PEI is not economically feasible and therefore the grower is no longer pursuing this option.

Potting Mix Slabs:
The grower has conducted repeated trials to examine the feasibility of producing G2 runner tips using plant bags (peat) containing locally produced potting mix (Professional Mix VPW 30). Results from 2016 and 2017 (see Section 16 and Appendix 2) demonstrate that peat-bag growing of G2 runner tips is not feasible for any of the three varieties tested. The grower could not correctly manage strawberry plant growth and runner production in rainy periods during the summer growing season with porous, woven peat bags and therefore the grower is no longer pursuing this option.

Botanicoir Precision Plus growbags:
The grower has been conducting trials to examine the feasibility of producing G2 runner tips using Botanicoir Plus Precision grow bags since 2016. Results for trials completed in 2016 and 2017 were unsatisfactory due to issues with the fertility program. These issues were addressed and in 2018 and 2019, and the grower achieved more positive results for the Chandler and Camarosa varieties.

However, in 2018 and 2019 the grower observed that soilless plants required an additional 3-4 weeks of growing time, relative to conventional plants, resulting in an additional late –September harvest, for which a market does not exist. In 2019, the grower constructed a greenhouse to produce soilless plants in an indoor environment, in order to overcome the three-week delay experienced with soilless production. In 2020, the grower moved all soilless research trials into the greenhouse.

As described in detail in Section 16, the 2020 results were quite positive. While the grower had no experience with indoor production prior to 2020, if they can improve the process, layout and selection of varieties to optimize the production of soilless runner tips indoors, they could achieve even higher ratios.

Improving upon the production ratios achieved indoors during the first season in the greenhouse will be the objective of the 2021 research trials. As the costs of indoor soilless production exceed that of conventional field-based production (see Section 24) and the shift to a soilless system will not produce higher quality runner tips, the increased costs cannot be passed on to the customer. As such, indoor soilless production must exceed that of conventional methods, and/or the grower must find significant cost savings for this approach to be economically viable.

3. Plug plants
The grower does not consider plug plants as a viable alternative, since nursery stock is more productive and vigorous than plug plants grown in substrates in greenhouses. When transplanted,

bare-root nursery plants become more vigorous when transplanted, due to acclimation to the Canadian climate. Plugs are normally only used for very early crop, which represents only a small proportion of the grower's field. Plugs are also much more expensive than bare-root plants, and shipping costs are at least five times higher: a finished plug plant in North Carolina in 2013 cost the grower \$235 to \$250/thousand, more than all other strawberry plant types, including bare-roots (about \$135/thousand), cut-offs (about \$120/thousand) and frigo (\$100-120/thousand). Furthermore, plug plants are not readily available in abundance in Canada.

A reference paper provided by the MBTOC by Lopez-Galarza, et al., (2010) states that "… *the plug technique has become more widespread due to generating higher profits compared with use of bare-root plants, especially after the banning of methyl bromide and despite its higher costs, which are a major restriction on the use of plug plants*." Experience in North Carolina with plugs and bare-roots does not support the conclusion that higher profits are possible with plug plants compared to bare-root fresh dug material. In fact, in the 2012-2013 season, bare-root plants from the PEI grower were earlier in ripening than plug plants of the same variety, and berry size was better with bare-roots than plugs.