Proposed Re-evaluation Decision PRVD2023-01

Abamectin and Its Associated End-use Products

Consultation Document

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Proposed re-evaluation decision for abamectin and associated end-use products

Under the authority of the *Pest Control Products Act,* all registered pesticides must be re-evaluated by Health Canada's Pest Management Regulatory Agency (PMRA) to ensure that they continue to meet current health and environmental standards and continue to have value. The re-evaluation considers data and information from pesticide manufacturers, published scientific reports and other regulatory agencies. Health Canada applies internationally accepted risk assessment methods as well as current risk management approaches and policies.

Abamectin is an acaracide/insecticide registered for use on a wide-range of outdoor field-grown fruit and vegetable crops, outdoor ornamentals, greenhouse vegetables and greenhouse ornamentals for the control or suppression of a variety of agricultural pests such as mites, sawflies, moths, thrips, leafminers, psyllids, aphids and certain beetles. It is also registered for commercial and domestic indoor and/or outdoor structural use to control cockroaches and ants. Currently registered products containing abamectin can be found in the Pesticide Product Information Database and in Appendix I. Appendix II lists all uses for which abamectin is presently registered.

This document presents the proposed re-evaluation decision for abamectin, including the proposed amendments (risk mitigation measures) to protect human health and the environment, as well as the science evaluation on which the proposed decision is based. All products containing abamectin that are registered in Canada are subject to this proposed re-evaluation decision. This document is subject to a 90-day public consultation period,[1] during which the public (including the pesticide manufacturers and stakeholders) may submit written comments and additional information to PMRA Publications. The final re-evaluation decision will be published after taking into consideration the comments and information received during the consultation period.

Proposed re-evaluation decision for abamectin

Under the authority of the *Pest Control Products Act* and based on an evaluation of available scientific information, Health Canada is proposing continued registration of some uses of abamectin and associated end-use products registered for sale and use in Canada. Risks to human health and the environment were shown to be acceptable when abamectin is used according to the proposed conditions of registration, which include the mitigation measures identified below

The following use of abamectin is proposed for cancellation since occupational postapplication risks were not shown to be acceptable when used according to the current conditions of registration, or when additional mitigation is considered:

- Greenhouse ornamentals grown for cut flowers

[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

With respect to human health, dietary exposure and risks were acceptable for the current conditions of use. For the application of abamectin via handheld airblast/mist blower, restriction to the amount handled per day is proposed for occupational risks to be acceptable, as well as the addition of specific personal protective equipment (PPE) when using this application equipment. Occupational mixer/loader and applicator exposures and risks were shown to be acceptable with the current conditions of use for all other application methods.

For occupational postapplication exposures to abamectin from onions (bulb and green), grapes and hops, restricted-entry intervals (REIs) ranging from 1–11 days are proposed for risks to be acceptable. Postapplication exposures and risks for all other crops were shown to be acceptable with current conditions of use (REI of 12 hours). Other PPE label instructions and spray drift statements are proposed to be updated to current standards.

The environmental risk assessment identified potential risk to pollinators, beneficial arthropods, birds, mammals and aquatic organisms when abamectin is used according to current label directions. The risks to the environment were shown to be acceptable when abamectin is used according to proposed conditions of registration, which includes new mitigation measures such as a reduced maximum cumulative application rate, the construction and maintenance of a vegetative filter strip to protect aquatic organisms and the use of spray buffer zones at the time of application.

Abamectin has value as an acaracide/insecticide as it is registered for use on a wide variety of field-grown fruit and vegetable crops, outdoor ornamentals, greenhouse vegetables and greenhouse ornamentals for the control or suppression of a variety of agricultural pests. It is also registered for commercial and domestic indoor and/or outdoor structural use to control cockroaches and ants. Abamectin is the only insecticide belonging to Mode of Action Group 6, neurotransmission inhibitor, therefore is a valuable tool in resistance management.

Risk mitigation measures

Registered pesticide product labels include specific directions for use. Directions include risk mitigation measures to protect human health and the environment and must be followed by law. The proposed label amendments including any revised/updated label statements and/or mitigation measures, as a result of the re-evaluation of abamectin, are summarized below. Refer to Appendix X for details.

Human health

As a result of the re-evaluation of abamectin, Health Canada is proposing further risk-reduction measures in addition to those currently included on abamectin product labels.

Risk mitigation:

To protect mixer/loaders and applicators using agricultural end-use products containing abamectin, the following risk-reduction measures are proposed:

- Add requirement for personal protective equipment (PPE) for application of abamectin via handheld airblast/mistblowers
    - Single layer (long-pants, long-sleeved shirt), chemical resistant gloves, chemical resistant coveralls, a chemical resistant hood and a respirator.
- Additionally, limit the amount handled per day for application of abamectin via handheld airblast mistblowers to 7.5 g a.i. per person per day.

To protect agricultural workers entering sites treated with abamectin, the following risk-reduction measures are proposed:

- Restricted-entry intervals (REIs) of 1–11 days for onions, grapes and hops.
- Cancel the use of abamectin on greenhouse ornamentals grown for cut flowers as agronomically feasible REIs could not be established.

Label updates to meet current standards:

All commercial class end-use product labels are proposed to be updated to current standards, as it pertains to label PPE and best practice statements (spray drift).

All commercial and domestic class structural end-use product labels are also proposed to be updated to include a precautionary statement to protect domestic animals/pets.

Environment

Risk mitigation:

To protect the environment, the following risk-reduction measures are proposed:

- Label statements to inform users of the potential risks to bees, beneficial arthropods, birds, small mammals, and aquatic organisms.
- Spray buffer zones to reduce the risk of spray drift to aquatic ecosystems.
- Mitigation measures to reduce the exposure to bees.
- To protect aquatic organisms, construction and maintenance of a 10 m wide vegetative filter strip and the maximum cumulative application rate not exceeding 38 g a.i./ha/per year.

International context

Abamectin is currently acceptable for use in other Organisation for Economic Co-operation and Development (OECD) member countries, including the United States, the European Union and Australia. No decision by an OECD member country to prohibit all uses of abamectin for health or environmental reasons has been identified as of 18 May 2022.

Next steps

Upon publication of this proposed re-evaluation decision, the public, including the registrants and stakeholders are encouraged to submit additional information that could be used to refine risk assessments during the 90-day public consultation period.

All comments received during the 90-day public consultation period will be taken into consideration in preparation of re-evaluation decision document[2] which could result in revised risk mitigation measures. The re-evaluation decision document will include the final re-evaluation decision, the reasons for it and a summary of comments received on the proposed re-evaluation decision with Health Canada's responses.

Refer to Appendix I for details on specific products impacted by this proposed decision.

Other information

The relevant confidential test data on which the proposed decision is based (see References Section) are available for public inspection, upon application, in PMRA's Reading Room. For more information, please contact PMRA's Pest Management Information Service.

Additional scientific information

Human Health

No additional scientific data are being requested. However, during the consultation period, the registrants and other stakeholders may submit the following information that could help address uncertainties in the available information for abamectin and support revised assessments of occupational post-application exposure and risk.

- **Occupational Exposure:** Dislodgeable foliar residue data for abamectin both outdoors and in greenhouses.

[2] "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Value

No additional scientific data are being requested. However, feedback is sought regarding two aspects of the proposed decision.

1) If registrants and users intend to request a delay of the implementation date of the proposed label amendments or cancellation (use on greenhouse ornamentals grown for cut flowers) of abamectin as per section 21 (3) of the *Pest Control Products Act*, Health Canada is seeking information on the suitability of the registered alternatives during the consultation period, including:

- Limitations and challenges of registered alternatives such as efficacy, documented resistance in target pests, adoptability of production practices (for example, application method, application timing, variety sensitivity, regional use restrictions, soil texture variations);
- Unique benefits provided by abamectin; and
- Importance of abamectin (for example, pest significance, volume of use, percent crop treated and impact without the active).

2) An application timing restriction is proposed to protect pollinators. For the following crops: pears, grapes, caneberries, strawberries, fruiting vegetables, cucurbit vegetables and tuberous and corm vegetables; application during the crop blooming period will not be permitted. Note that this restriction is currently labeled for apples. Stakeholders are asked to provide comment on the impact this restriction on managing pests that would be targeted during the blooming period.

Science evaluation

1.0 Introduction

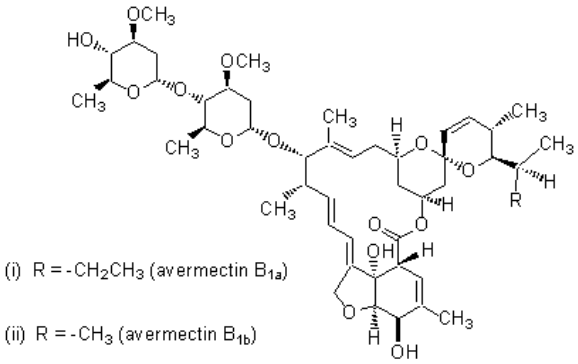
Abamectin is an acaracide/insecticide registered for use on a wide-range of outdoor field-grown fruit and vegetable crops, outdoor ornamentals, greenhouse vegetables and greenhouse ornamentals for the control or suppression of a variety of agricultural pests such as mites, sawflies, moths, thrips, leafminers, psyllids, aphids and certain beetles. It is also registered for commercial and domestic indoor and/or outdoor structural use to control cockroaches and ants. It is valuable to both the agricultural crop production and structural sectors for resistance management because it is the only MOA Group 6 active ingredient registered.

Appendix I lists all abamectin products that are registered under the authority of the *Pest Control Products Act*. Appendix II lists all the uses for which abamectin is presently registered.

2.0 Technical grade active ingredient

2.1 Identity

Common name	Abamectin
Function	Acaricide, Insecticide
Chemical family	Avermectins (macrocylic lactones isolated from *Streptomyces avermitilis*)
Chemical name	
1 International Union of Pure and Applied Chemistry (IUPAC)	mixture of ≥ 80% (10*E*,14*E*,16*E*)-(1*R*,4*S*,5′*S*,6*S*,6′*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-6′-[(*S*)-*sec*-butyl]-21,24-dihydroxy-5′,11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2′-(5′,6′-dihydro-2′*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside and ≤ 20% (10*E*,14*E*,16*E*)-(1*R*,4*S*,5′*S*,6*S*,6′*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-21,24-dihydroxy-6′-isopropyl-5′,11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2′-(5′,6′-dihydro-2′*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside

2 Chemical Abstracts Service (CAS)	Avermectin B_1
CAS registry number	71751-41-2 65195-55-3 (avermectin B_{1a}) 65195-56-4 (avermectin B_{1b})
Molecular formula	$C_{48}H_{72}O_{14}$ (avermectin B_{1a}) $C_{47}H_{70}O_{14}$ (avermectin B_{1b})
Structural formula	
Molecular weight	$C_{48}H_{72}O_{14}$ (avermectin B_{1a}) $C_{47}H_{70}O_{14}$ (avermectin B_{1b})
Purity of the technical grade active ingredient	92.1%
Registration number	24484

2.2 Physical and chemical properties

Property	Result
Vapour pressure at 25°C	<0.0037 mPa
Ultraviolet (UV) / visible spectrum	In methanol: Neutral: λ_{max} 244.0, ε (L·mol^{-1}·cm^{-1}) 31710.5 Acidic: λ_{max} 244.0, ε (L·mol^{-1}·cm^{-1}) 30834.1 Basic: λ_{max} 244.0, ε (L·mol^{-1}·cm^{-1}) 29535.9
Solubility in water at 20–25°C	1.21 mg/L
n-Octanol/water partition coefficient	log K_{ow} 4.4 (pH 7.2)
Dissociation constant	No pKa observed between 3 and 11

3.0 Human health assessment

3.1 Toxicology summary

The toxicology reference values used for human health risk assessment are summarized in Table 1 (Appendix III). The PMRA reviewed the toxicological database for abamectin, which includes toxicity studies with abamectin, its components avermectin B1a and avermectin B1b, and the photolytic degradation products, including the delta 8,9-isomer of avermectin B1a. The primary target of abamectin toxicity is the nervous system.

For further details, please refer to Canada 2001 and Canada 2016.

3.1.1 *Pest Control Products Act* hazard characterization

For assessing risks from potential residues in food or from products used in or around homes or schools, the *Pest Control Products Act* requires the application of an additional 10-fold factor to threshold effects to take into account completeness of the data with respect to the exposure of, and toxicity to, infants and children, and potential prenatal and postnatal toxicity. A different factor may be determined to be appropriate on the basis of reliable scientific data.

The PMRA characterised the PCPA factor for abamectin and determined that a threefold factor should be retained for risk assessment to address the uncertainty with respect to sensitivity of the young (Canada, 2016).

3.2 Dietary exposure and risk assessment

In a dietary exposure assessment, Health Canada determines how much of a pesticide residue, including residues in meat and milk, may be ingested with the daily diet. Exposure to abamectin from potentially treated imported foods is also included in the assessment. Dietary exposure assessments are age-specific and incorporate the different eating habits of the population at various stages of life (infants, children, adolescents, adults and seniors). For example, the assessments take into account differences in children's eating patterns, such as food preferences and the greater consumption of food relative to their body weight when compared to adults. Dietary risk is then determined by the combination of the exposure and the toxicity assessments. High toxicity may not indicate high risk if the exposure is low. Similarly, there may be risk from a pesticide with low toxicity if the exposure is high.

Health Canada considers limiting use of a pesticide when exposure exceeds 100% of the reference dose. Health Canada's Science Policy Note SPN2003-03, Assessing Exposure from Pesticides, A User's Guide, presents detailed risk assessment procedures.

Residue estimates used in the dietary risk assessment may be based conservatively (in other words, are high-end estimates) on the maximum residue limits (MRLs) or the field trial data representing the residues that may remain in or on food after treatment at the maximum label rate. Surveillance data representative of the national food supply may also be used to derive a more accurate estimate of residues that may remain in or on food when it is purchased. These include the Canadian Food Inspection Agency's (CFIA) National Chemical Residue Monitoring

Program and the United States Department of Agriculture Pesticide Data Program (USDA PDP). Specific and empirical processing factors as well as specific information regarding percent of crops treated may also be incorporated to the greatest extent possible.

Sufficient information was available to adequately assess the dietary exposure and risk to abamectin. Acute and chronic dietary exposure and risk assessments were conducted using the Dietary Exposure Evaluation Model - Food Commodity Intake Database™ (DEEM-FCID™, Version 4.02, 05-10-c) program which incorporates consumption data from the National Health and Nutrition Examination Survey/What We Eat in America (NHANES/WWEIA) for the years 2005-2010 available through the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). Further details on the consumption data are available in Health Canada's Science Policy Note SPN2014-01, General Exposure Factor Inputs for Dietary, Occupational and Residential Exposure Assessments.

Canadian MRLs for abamectin and the current residue definition for enforcement are available on the Pesticides section of the Canada.ca website. The current residue definition for enforcement and risk assessment on "all food commodities" (implied plants and animals) has been established as "avermectin B_1 (a mixture of avermectins containing greater than or equal to 80% avermectin B_{1a} (5-O-demethyl avermectin A_{1a}) and less than or equal to 20% avermectin B_{1b} (5-O-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl) avermectin A_{1a}) and its delta-8,9-isomer") [Note: abamectin also called avermectin B_1, delta-8,9-isomer also called 8,9-Z isomer]. As a result of the review of food residue chemistry studies, Health Canada is proposing to 1) specify the residue definition for enforcement and risk assessment as "Avermectin B_{1a}"; and 2) since there are no MRLs established for animal commodities in Canada for pesticidal uses, the current description of commodities is proposed to be revised to state "all food crops" instead of "all food commodities". These proposed changes are aligned with Codex, veterinary drugs and Canadian Food Inspection Agency (CFIA) practices.

Health Canada is proposing a revision to the residue definition for drinking water assessment as follows: avermectin B_{1a}, 8,9-Z isomer of avermectin B_{1a}, avermectin B_{1b}, 8,9-Z isomer of avermectin B_{1a}, as well as transformation products NOA44811, NOA44812, NOA426289, NOA445495, NOA457464 and NOA457465.

3.2.1 Determination of acute reference dose (ARfD)

To estimate acute dietary risk (1 day), the acute neurotoxicity study in rats with a NOAEL of 0.5 mg/kg bw was selected for risk assessment. Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability were applied and a PCPA factor of threefold was considered appropriate. The composite assessment factor (CAF) is thus 300, resulting in an ARfD of 0.0017 mg/kg bw of abamectin. The ARfD is considered protective of all populations, including females of child-bearing age and nursing infants. Details on the derivation of the acute reference dose can be found in Canada, 2016.

3.2.2 Acute dietary exposure and risk assessment

The acute dietary risk was calculated considering the highest ingestion of abamectin that would be likely on any one day and using food and drinking water consumption and residue values. The expected intake of residues is compared to the ARfD, which is the dose at which an individual could be exposed on any given day and expect no adverse health effects. When the expected intake of residues is less than the ARfD, the acute dietary exposure has been shown to be acceptable.

A refined acute food residue estimates for abamectin were based on the maximum residues in CFIA 2013-2017 monitoring data, the highest average field trail (HAFT) residue levels detected in the available crop field trials, anticipated residues in ruminant animal commodities, and Canadian MRLs, American Tolerances or Codex MRLs. Residue data were translated from representative commodities in the crop groups to other commodities within the crop group according to Health Canada's guidelines. All crops were assumed to be 100% treated. Default and experimental food processing factors were applied for relevant processed commodities. Where possible, experimental processing factors were extrapolated according to OECD Guidelines. The assessment considered all foods that may potentially be treated with abamectin including imported foods that may be treated outside of Canada.

Acute dietary exposure from both food and drinking water was determined by incorporating drinking water EECs from modelling discussed in Section 3.3.

The acute dietary exposure to abamectin and its metabolites from food and drinking water did not exceed 31% of the ARfD; and therefore, risks were shown to be acceptable. Infants <1 years old represented the highest exposed subpopulation. The major risk contributor was drinking water, occupying 84% of the total exposure. The acute dietary risk estimates are presented in Appendix IV, Table 1.

3.2.3 Determination of acceptable daily intake (ADI)

To estimate risk of repeated dietary exposure, the results of the developmental neurotoxicity (DNT) studies in rats were considered. The offspring NOAEL of 0.12 mg/kg bw/day from the DNT study was selected for risk assessment. The selection of this study was supported by the findings of a supplemental 1-generation reproduction toxicity study with avermectin B1a in rat. Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability were applied and a PCPA factor of threefold was considered appropriate. The composite assessment factor (CAF) is thus 300, resulting in an ADI of 0.0004 mg/kg bw/day of abamectin. The ADI is considered protective of all populations, including females of child-bearing age and nursing infants. Details on the derivation of the ADI can be found in Canada, 2016.

3.2.4 Chronic dietary exposure and risk assessment

Generally, the chronic dietary risk (from food and drinking water) is calculated using average consumption of different foods and drinking water, and the average residue values on those foods and drinking water. The estimated exposure is then compared to the ADI, which is an estimate of the level of daily exposure to a pesticide residue that, over a lifetime, is believed to have no significant harmful effects. When the estimated exposure is less than the ADI, the chronic dietary exposure is shown to be acceptable.

A refined chronic food residue estimates for abamectin were based on mean values of the CFIA 2013-2017 monitoring data, the median residue levels detected in the available crop field trials, anticipated residues in ruminant animal commodities, and Canadian MRLs/American Tolerances or Codex MRLs. Residue data were translated from representative commodities in the crop groups to other commodities within the crop group according to Health Canada's guidelines. Updated percent crop treated information (both Canadian and United States) was used for the chronic risk assessment. Default and experimental food processing factors were applied for relevant processed commodities. Where possible, experimental processing factors were extrapolated according to OECD Guidelines. The assessment considered all foods that may potentially be treated with abamectin including imported foods that may be treated outside of Canada.

Chronic dietary exposure from both food and drinking water was determined by incorporating drinking water EECs from modelling discussed in Section 3.3.

The chronic dietary risk assessment was conducted for the general population and all population subgroups. Chronic dietary exposures from food and drinking water did not exceed 30% of the ADI; and therefore, risks were shown to be acceptable. Infants <1 year old represented the highest exposed subpopulation. Pome fruits (~11% of the total exposure), tropical fruits (~6% of the total exposure), legume vegetables (~7% of the total exposure) and drinking water (~58% of the total exposure) are the major contributors. The chronic dietary risk estimates are presented in Appendix IV, Table 2.

As a result of this re-evaluation, dietary risks were shown to be acceptable from exposure to abamectin through food and drinking water. Therefore, no numeric amendments to the currently established MRLs are being proposed as part of the re-evaluation decision and the current Canadian MRLs for abamectin will be maintained.

3.2.5 Cancer assessment

There was no evidence of carcinogenicity in the abamectin toxicological database and, therefore, a cancer risk assessment is not required (Canada, 2016).

3.3 Exposure from drinking water

3.3.1 Concentrations in drinking water

Estimated environmental concentrations (EECs) in potential drinking water sources were calculated using Pesticide in Water Calculator (PWC) model, version 1.52 for both groundwater and surface water. The drinking water modelling was conducted for the proposed residue definition for drinking water assessment (in other words, a combined residue of abamectin and its major transformation products (NOA448111, NOA448112, NOA 426289, NOA 445495, NOA 457464 and NOA 457465)). For surface water, PWC calculates the amount of pesticide entering the water body by runoff and drift, and the subsequent transformation of the pesticide in the water system. EECs are calculated by modelling a total land area of 173 ha draining into a 5.3 ha reservoir with a depth of 2.7 m. Groundwater EECs are calculated by simulating leaching through a layered soil profile and

reporting the average concentration in the top 1m of a water table.

Drinking water modelling follows a tiered approach consisting of progressive levels of refinement. Level 1 EECs are conservative values intended to screen out pesticides that are not expected to pose any concern related to drinking water. These are calculated using conservative inputs with respect to application rate, application timing, and geographic scenario. Level 1 EECs cover all regions of Canada. Level 2 EECs are based on a narrower range of application timing, methods, and geographic scenarios, and are not considered conservative values that cover all regions of Canada. Major fate inputs for the modelling are summarized in Appendix IX, Table 1.

Modelling was performed at Level 1 (using current registered cumulative rates on agricultural crops and outdoor ornamentals). Canadian drinking water monitoring data for abamectin was not available. Level 1 EECs are reported in Appendix IX, Table 2a. The daily surface water EEC for abamectin and transformation products (2.5 µg/L) was used in the acute assessment, and the yearly surface water EEC (0.91 µg/L) was used in the chronic assessment.

3.3.2 Drinking water exposure and risk assessment

Exposure from drinking water and food sources were combined to determine the total dietary exposure and risk. Refer to Sections 3.2.2 and 3.2.4 as well as Appendix IV for the results of the acute and chronic dietary exposure and risk assessments.

3.4 Occupational and non-occupational exposure and risk assessment

Occupational and non-occupational (for example, residential) risk is estimated by comparing potential exposures with the most relevant endpoint from toxicology studies to calculate a margin of exposure (MOE). This is compared to a target MOE incorporating uncertainty factors protective of the most sensitive subpopulation. If the calculated MOE is less than the target MOE, it does not necessarily mean that exposure will result in adverse effects, but mitigation measures to reduce risk would be required.

3.4.1 Toxicology reference values

Toxicology reference values used in the assessment are summarized in Appendix III.

3.4.1.1 Short-, Intermediate, and Long-Term- dermal and inhalation

For dermal and inhalation risk assessments of all durations, the offspring NOAEL of 0.12 mg/kg bw/day from the rat DNT study was selected. At the LOAEL of 0.2 mg/kg bw/day, decreased pup body weight was observed. The selection of this study was supported by the findings from a supplemental 1-generation reproductive toxicity study with avermectin B1a in the rat, in which spastic movements in pups were observed at 0.2 mg/kg bw/day, with no adverse findings recorded at 0.1 mg/kg bw/day. Route-specific studies assessing the endpoints of concern were not available, thus necessitating the use of an oral study for risk assessment.

For residential scenarios, the target MOE selected for this endpoint is 300. Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability are applied. As noted in section 3.1.1, a PCPA factor of threefold is considered appropriate. The selection of this study and target MOE is considered to be protective of all populations, including the unborn children and nursing infants of exposed women.

For occupational scenarios, the target MOE selected for this endpoint is 300. Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability are applied. As the worker population could include pregnant or lactating women, it is necessary to afford adequate protection of the fetus or nursing infant that may be exposed via their mother. In light of the uncertainty regarding potential sensitivity of the young noted in *Pest Control Products Act* hazard characterization section, an additional threefold factor was applied to this endpoint to protect all subpopulations, including the nursing or unborn children of exposed female workers.

3.4.1.2 Acute incidental oral (Non-dietary)

For the assessment of an acute incidental oral (non-dietary) scenario, the NOAEL of 0.5 mg/kg bw from the acute neurotoxicity study in rats is considered appropriate. At the LOAEL of 1.5 mg/kg bw, decreased splay reflex was observed. Selection of this study and NOAEL is supported by the results in the 12-week dog toxicity study for which a NOAEL of 0.5 mg/kg bw/day was established. At the LOAEL of 1.0 mg/kg bw/day, mydriasis was observed in the first week of dosing. The specific timing of this observation was not clear; however, examination of the collective results of the dog studies indicated that at higher doses, mydriasis was observed within 24 hours of initial treatment. Therefore, the possibility that mydriasis may have resulted following a single dose at 1.0 mg/kg bw/day could not be ruled out, and for this reason it was considered supportive evidence for the acute risk assessment. Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability are applied. As noted above, a PCPA factor of threefold is considered appropriate. The target MOE is therefore 300.

3.4.1.3 Short-term incidental oral (Non-dietary)

For the assessment of a scenarios where the incidental oral exposure may be more short-term in nature, the appropriate endpoint is the same as that used for all repeat-dose scenarios (in other words, the NOAEL of 0.12 mg/kg bw/day based on decreased pup weight in the DNT study). Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability are applied. As noted above, a PCPA factor of threefold is considered appropriate. The target Margin of Exposure (MOE) is therefore 300.

3.4.1.4 Cancer assessment

There was no evidence of carcinogenicity in the abamectin toxicological database and, therefore, a cancer risk assessment is not required (Canada, 2016).

3.4.1.5 Dermal absorption factor

A dermal absorption value of 1% was used for abamectin based on a well conducted monkey in vivo study based on current practices and policies.

3.4.2 Occupational exposure and risk assessment

There is potential for exposure to abamectin in occupational scenarios from workers handling abamectin end-use products during mixing/loading and application activities, and from workers entering previously treated areas.

3.4.2.1 Mixer, loader, and applicator exposure and risk assessment

For commercial-class products, there are potential exposures for mixers, loaders, and applicators. The following occupational handler scenarios were assessed:

- Mixing/loading of emulsifiable concentrates or suspensions;
- Groundboom application to caneberries, celery, grapes, onions, hops, potatoes, strawberries;
- Airblast application to apples, grapes, hops and pears;
- Mixing, loading, and applying by backpack equipment to greenhouse cucumbers,

peppers, tomatoes and greenhouse ornamentals;
- Mixing, loading, and applying by manually pressurized handwand (MPHW) equipment to greenhouse cucumbers, peppers, tomatoes and greenhouse ornamentals;
- Mixing, loading, and applying by mechanically pressurized handgun (MPHG) to greenhouse cucumbers, peppers, tomatoes and greenhouse ornamentals;
- Mixing, loading and applying by handheld airblast/mistblower (HH AB/MB) to apples, grapes, hops, pears and greenhouse cucumbers, peppers, tomatoes and ornamentals;
- Mixing, loading and applying granular/dry flowable ant and cockroach pest control products into cracks, crevices and voids via centrobulb duster or other appropriate equipment.

Based on the number of applications and timing of applications, workers applying abamectin to agricultural crops (non greenhouse) would generally have short- to intermediate-term exposure (< 30 days to < 6 months). Workers applying abamectin to greenhouse crops and ornamentals would, additionally, have long-term exposure (> 6 months). Pest control operators (PCOs) applying commercial ant and cockroach control products in indoor environments would have short- to intermediate-term exposure (< 30 days to < 6 months).

The exposure estimates for the occupational exposure and risk assessment for mixers/loaders and applicators are based on different levels of PPE and engineering controls:

- For all scenarios except applicators of handheld airblast/mistblower (HH AB/MB) the following PPE was assumed:
    - Baseline PPE: Long pants, long-sleeved shirt and chemical-resistant gloves.
    - Engineering Controls: represents the use of appropriate engineering controls, such as closed-cab tractor or closed mixed/loading systems.
- For applicators of handheld airblast/mistblowers (HH AB/MB), the following PPE was assumed:
    - Single layer (long-pants, long-sleeved shirt), chemical resistant gloves, chemical resistant coveralls, a chemical resistant hood and a respirator.

No appropriate chemical-specific handler exposure data were available for abamectin. Therefore, dermal and inhalation exposure were estimated using data from the Pesticide Handlers Exposure Database (PHED) and the Agricultural Handler Exposure Task Force (AHETF).

The PHED version 1.1 is a compilation of generic mixer/loader and applicator passive dosimetry data with associated software which facilitates the generation of scenario-specific exposure estimates based on formulation type, application equipment, mix/load systems and level of personal protective equipment. The AHETF was formed in 2001 with the objective of providing more up-to-date generic exposure data to replace the data currently being used in the PHED. The open cab groundboom and open mix/load liquid scenarios from AHETF were used.

Two worker exposure studies were submitted to the PMRA that monitored workers when applying pesticides using application equipment representative of handheld airblast/mistblowers (HH AB/MB). One study (Thouvenin, 2015) monitored dermal exposure, while the other study (Testman, 2015) monitored inhalation exposure. These studies were reviewed by the PMRA and the calculated dermal and inhalation unit exposures were determined to be acceptable for assessing applicator exposure when using this type of equipment.

Inhalation exposures were based on light inhalation rates (17 L/min) except for the backpack sprayer, which was assessed using a moderate inhalation rate (27 L/min). While there are limitations in the use of generic data, these exposure data represent the most reliable information currently available.

Abamectin is also applied via crack and crevice application or loaded into bait stations for commercial ant and cockroach control in residences. There are no specific PHED or AHETF exposure scenarios to model these scenarios. The PHED Granular-Bait by Hand exposure scenario was used as a high-end estimate that would adequately cover any expected exposure to applying abamectin via crack and crevice application and the loading of abamectin into bait stations. The use of the PHED Granular – Bait by Hand exposure estimate is not expected to underestimate exposure.

For application of abamectin via HH AB/MB, there are risks of concern when considering the maximum application rate and spray volume. To mitigate these risks, a limit to the amount handled per day for this application equipment is proposed. When considering this mitigation measure, there are no longer risks of concern associated with the application of abamectin via HH AB/MB. For all other uses of abamectin on agricultural crops and in greenhouses, calculated MOEs exceeded target MOEs, for all mixing, loading, and application scenarios at baseline PPE. Therefore, when considering mitigation measures, where appropriate, risks were shown to be acceptable for all agricultural and greenhouse uses of abamectin. Results are summarized in Appendix V, Table 1.

For commercial control of pests in and around residences, calculated MOEs exceeded target MOEs, for all mixing, loading, and application scenarios at baseline PPE. Therefore, risks were shown to be acceptable. Results are summarized in Appendix V, Table 2.

3.4.2.2 Postapplication worker exposure and risk assessment

The postapplication occupational risk assessment considered exposures to workers entering treated sites to conduct agronomic activities involving contact with treated material (such as, foliage). For agricultural workers, there is potential for short- (1–30 days) to intermediate-term (30 days to 6 months) postapplication exposure when entering previously treated outdoor agricultural areas, and also potential for long-term (6 months to 1 year) postapplication exposure when entering previously treated greenhouses. Exposure would be predominantly dermal for workers performing postapplication activities on treated agricultural and greenhouse crops. Based on the vapor pressure of abamectin, inhalation exposure is expected to be low, provided that the minimum restricted-entry interval (REI) is followed. There is no expected postapplication exposure associated with PCOs applying abamectin products in and around residences, as the PCO is not expected to perform any postapplication activities or re-enter treated areas/residences.

Potential dermal exposure to postapplication workers was estimated using activity-specific transfer coefficients (TCs) and dislodgeable foliar residue (DFR) data. DFR refers to the amount of residue that can be dislodged or transferred from a surface, such as leaves of a plant. The TC is a measure of the relationship between exposure and DFRs for individuals engaged in a specific activity and is calculated from data generated in field exposure studies. The TCs are specific to a given crop and activity combination (for example, hand harvesting apples, scouting late season corn) and reflect standard agricultural work clothing worn by adult workers.

Activity-specific TCs from the Agricultural Re-Entry Task Force (ARTF) were used. For more information about estimating worker post application exposure, refer to PMRA's Regulatory Proposal PRO2014-02 (*Updated Agricultural Transfer Coefficients for Assessing Occupational Exposure to Pesticides*).

Since no chemical-specific DFR studies were available for abamectin, default values were used (peak DFR of 25% if the application rate for all crops, with 10% and 2% dissipation rate per day for outdoor crops and greenhouse crops, respectively). For further information on these default values, refer to PMRA's Science Policy Note SPN2014-02, Estimating Dislodgeable Foliar Residues and Turf Transferable Residues in Occupational and Residential Post-application Exposure Assessments.

For workers entering a previously treated site, restricted-entry intervals (REIs) are calculated to determine the minimum length of time required before people can safely enter after application. An REI is the duration of time that must elapse before residues decline to a level where performance of a specific activity results in exposures above the target MOE.

Appendix VI summarizes the postapplication risk assessment including the REIs determined for each crop and activity combination. For all agricultural scenarios except greenhouse ornamentals for cut flowers, calculated MOEs were higher than the target MOE at REIs ranging from 12 hours to 11 days. For some registered uses, REIs required revisions to mitigate the potential postapplication occupational risk. For greenhouse ornamentals grown for cut flower production, MOEs were less than the target MOE and risks were unacceptable for all postapplication activities on the day of final application and were still unacceptable up to 45 days after application. An REI of 45 days was determined to not be agronomically feasible for greenhouse ornamentals grown for cut flower production and, as such, this use is proposed for cancellation. Therefore, except in the case of greenhouse ornamentals grown for cut flower production, risks associated with postapplication exposure of workers to abamectin are considered acceptable, provided that the proposed REIs are followed.

3.4.3 Non-occupational exposure and risk assessment

Non-occupational (for example, residential) risk assessment involves estimating risks to the general population, including youth and children, during or after pesticide application.

The USEPA has generated standard default procedures for developing residential exposure assessments for both applicator and postapplication exposures when chemical- and/or site-specific field data are limited. These procedures may be used in the absence of, or as a supplement to, chemical- and/or site-specific data and generally result in high-end estimates of exposure. These procedures relevant to the abamectin re-evaluation are outlined in the 2012 USEPA Standard Operating Procedures (SOP) for Residential Pesticide Exposure Assessments under the following section:

- Section 4: Garden and Trees
- Section 7: Indoor Environments

3.4.3.1 Residential applicator exposure and risk assessment

A residential applicator is an individual (≥ 16 years old) who applies a domestic class product in and around the home. As outlined in the USEPA Residential SOPs (2012), residential applicators are assumed to be wearing shorts, short-sleeved shirts, shoes and socks during application. The residential applicator has the potential for short-term exposure (1–30 days) when applying products containing abamectin.

All currently registered domestic class products containing abamectin are formulated in Ready-To-Use (RTU), child resistant bait stations. Therefore, and according to the USEPA Residential SOPs (2012) minimal residential handler exposure (dermal and inhalation) is expected and no quantitative assessment was conducted. All risks associated with application of domestic class products containing abamectin are considered acceptable.

3.4.3.2 Residential postapplication exposure and risk assessment

Residential postapplication exposure occurs when an individual is exposed through dermal, inhalation, and/or incidental oral (non-dietary ingestion) routes as a result of being in a residential environment that has been previously treated with a pesticide. There is potential for residential postapplication exposure via application of abamectin to indoor environments (bait stations, and crack and crevice application) and to residential fruit trees (foliar spray to apple and pear trees).

For the application of abamectin to residential fruit trees (pear and apple) residential postapplication exposure to abamectin is expected to be of short-term duration (1–30 days of exposure). It was assumed that individuals would contact trees on the same day the pesticide was applied. For this scenario, adults (> 16 years old) and children (6 < 11 years old) were chosen as the index lifestages to assess residential post-application exposures, based on behavioural characteristics and the quality of available data. Exposure is expected to be predominantly dermal in nature. It is assumed that younger children (in other words, < 6 years old) won't utilize these areas for playing nor engage in the types of activities associated with these areas (for example, picking fruit) to the extent that older children will.

Postapplication dermal exposure was calculated using activity-specific transfer coefficients (TCs) and exposure time from the USEPA Residential SOPs (2012). A TC is a factor that relates dermal exposure to dislodgeable foliar residues (DFR) and is based on the amount of treated surface that a person contacts while performing activities in a given period (usually expressed in the units cm^2 per hour). It is specific to a particular population and activity/location (example, adults conducting maintenance activities on residential fruit trees). As the abamectin use pattern only includes apple and pear trees, as it pertains to commercial application in residential areas, the residential postapplication exposure and risk assessment only quantified exposure and risk to previously treated fruit trees.

Inhalation is not considered to be a significant route of postapplication exposure for people entering treated areas following tree applications due to the combination of the low vapour pressure of abamectin and the expected dilution in outdoor air. Therefore, for these scenarios, a quantitative postapplication inhalation exposure assessment was not required.

For the application of abamectin in and around residences, pest control operators (PCOs) will apply commercial class abamectin end-use products only in areas that are inaccessible to children or pets (for example, to cracks, crevices and voids), or in child resistant bait stations that are secured in place. Since the product is only applied to inaccessible areas or in bait stations, postapplication dermal and incidental oral exposure is expected to be minimal, as the active ingredient would not be available for contact. As abamectin is considered non-volatile, and these structural products are applied or placed in areas that are inaccessible for contact, postapplication inhalation exposure is also expected to be minimal.

Calculated dermal MOEs exceeded the target MOEs for abamectin for all populations and thus, risks were shown to be acceptable. The results of the residential postapplication risk assessment are summarized in Appendix VII.

3.5 Aggregate exposure and risk assessment

Aggregate exposure is the total exposure to a single pesticide that may occur from dietary (food and drinking water), residential, and other non-occupational sources, and from all known or plausible exposure routes (oral, dermal and inhalation). Short- to intermediate-term aggregate exposure to abamectin may be comprised of food, drinking water, and residential exposure via the dermal and inhalation routes.

3.5.1 Toxicology endpoint selection for aggregate risk assessment

The toxicology endpoint selected for aggregation for all populations was decreased pup body weight. The offspring NOAEL of 0.12 mg/kg bw/day from the rat DNT study was selected for all routes and durations of exposure with a target MOE of 300. The PCPA factor for all routes was threefold as noted in the *Pest Control Products Act* hazard characterizations Section.

3.5.2 Residential, non-occupational and dietary aggregate exposure and risk assessment

In an aggregate risk assessment, the combined potential risk associated with food, drinking water and various residential (non-occupational) exposure pathways are assessed. A major consideration in the likelihood of co-occurrence of exposures and durations of exposure. Additionally, only exposures from routes that share common toxicological effects are aggregated.

For abamectin, aggregate exposures would be expected for adults and children (6 to < 11 years old) who would have residential exposure following application of abamectin to residential trees (apple and pear trees) and background (chronic) dietary exposure from food and drinking water. The duration of residential exposure would be short- to intermediate-term.

The residential exposure would predominantly be via the dermal route and was shown to be acceptable (see Section 3.4.2). Inhalation exposure is expected to be very low compared to other routes of exposure and therefore was not considered quantitatively. Chronic dietary (food and drinking water) exposure was shown to be acceptable (see Section 3.2.4). No incidental oral exposure is expected.

Aggregate assessments were conducted for adults and children considering residential postapplication to treated residential trees and background dietary exposures from food and drinking water). Results are presented in Appendix VIII. The calculated aggregate MOEs exceed the target MOEs for all age groups assessed. Therefore, aggregate risks for abamectin are shown to be acceptable.

The abamectin use pattern also includes cockroach and ant control in and around residences applied by PCOs. PCOs may only apply abamectin in and around residences, specifically, via crack and crevice application, in places inaccessible to children and pets and in enclosed bait stations that are secure in place. In this scenario, there would be no expected non-occupational dermal contact with abamectin from those entering residential areas. Furthermore, the commercial class abamectin end-use products that are used for ant and cockroach control are formulated as dry flowables, pastes or granules, which are solid and non-volatile in nature; therefore, non-occupational inhalation exposure associated with the use of these products is expected to be minimal. All non-occupational exposure associated with re-entering residential areas that have been previously treated by commercial class abamectin ant and cockroach control end-use products is considered minimal and was not quantified in the aggregate exposure and risk assessment.

3.6 Cumulative assessment

The *Pest Control Products Act* requires Health Canada to consider the cumulative effects of pest control products that have a common mechanism of toxicity. Accordingly, an assessment of a potential common mechanism of toxicity with other pesticides was undertaken for abamectin. Abamectin belongs to the avermectin class of insecticides and shares a similar toxicological profile with another member of this class, emamectin benzoate .The USEPA has determined that there is evidence to suggest these chemicals may have a common mechanism of toxicity related to gamma-aminobutyric receptor mediated neurotoxicity [USEPA, 2017] Although abamectin is the only member of the avermectins registered as a pesticide in Canada, another member, emamectin benzoate, is registered as a pesticide for uses on food crops in the United States and thus Canadians could potentially be exposed to this pesticide via imported food commodities. In determining the need to conduct a cumulative risk assessment, other important considerations must be explored, such as defining and comparing the use patterns of the chemicals belonging to a common mechanism group to determine if the same uses are registered, whether the uses are wide-ranging, if there are residential uses, and the potential for co-occurrence of exposure to the different chemicals. In addition, monitoring data from the Canadian Food Inspection Agency (CFIA) and/or the United States Department of Agriculture (USDA) Pesticide Data Program (PDP) are important sources of real-world data for dietary exposure assessment when conducting a cumulative risk assessment.

Based on the available monitoring data collected over a decade (>132 000 samples) for both abamectin and emamectin in food crops, it was concluded that quantifiable residues are not expected in most treated crops. In fact, for the vast majority of samples tested, no detectable residues were observed. Only 0.08% of samples tested had residues above or equal to the limit of detection (LOD). Only two samples tested by CFIA had residues of emamectin B_{1a} above 0.1 ppm, in other words, the GMRL. Notably, there have been no detects (in other words, residues < LOD) of abamectin or emamectin (in the forms of benzoate salt, emamectin B_{1a} or emamectin B_{1b}) since 2015. As such, no co-occurrence of quantifiable residues originating from either abamectin or emamectin are expected on any crops. In addition, there is no residential exposure to emamectin since it is not registered for use in Canada.

Overall, based on consideration of the available information as required under section 7(7)(b)(i) of the *Pest Control Products Act*, cumulative risks from potential co-exposure to abamectin and emamectin are acceptable.

The USEPA recently conducted a quantitative cumulative risk assessment for abamectin and emamectin benzoate and concluded that there were no cumulative risks of concern. The USEPA took into consideration the more extensive use pattern that exists in the United States than in Canada. Health Canada will continue to monitor the available information on this class of pesticides. If new information becomes available that indicates the need for a cumulative assessment, this will be conducted as a stand-alone evaluation, which is consistent with the process described in Health Canada's framework on cumulative health risk assessment (SPN2018-02).

3.7 Health incident reports

As of 2 August 2022, the PMRA has received 30 human, 105 domestic animal and 4 packaging failure incident reports.

Approximately one quarter of the human incidents were considered to be associated with exposure to abamectin. All of these incidents occurred in Canada and were minor or moderate in nature. Most individuals were exposed during product use – either applying the product to registered use sites using appropriate application methods; applying the product to an unregistered use site; or using application methods not approved on the product label. The available information strongly suggests that the required personal protective equipment was not worn in these incidents. Reported symptoms included minor skin, respiratory, and general effects. One case of accidental ingestion was also reported and involved nausea and abdominal pain. Since the number of associated human cases is low, and almost all incidents were the result of not following the directions and personal protective equipment requirements on the product label, no additional mitigation is recommended in terms of human health.

Just over half of the 105 domestic animal incidents submitted had some association with exposure to abamectin. Most associated incidents occurred in Canada, with a few occurring in the U.S. In Canadian incidents, dogs exhibited minor and moderate gastrointestinal and general effects when exposed to ant and/or cockroach baits. These types of exposures were also seen in half of the incidents received from the United States. These incidents highlighted a recurring issue of domestic animals ingesting abamectin in ant and/or cockroach baits. To inform the consumer and applicator, and to improve consistency on abamectin product labels, the wording "Keep out of reach of domestic animals." is proposed to be added to the statement of all abamectin products used in and around homes, commercial and industrial buildings.

In the remaining American incidents, cows, sheep, and a dog died after ingesting seed treated with abamectin and other insecticides and fungicides. Abamectin is not registered for seed treatment in Canada, therefore, no additional mitigation measures are recommended based on these incidents.

See Appendix X for required label changes.

4.0 Environmental assessment

4.1 Fate and behaviour in the environment

A summary of environmental fate data for abamectin is presented in Appendix IX, Table 3.

Abamectin has low solubility in water, low vapour pressure (1.5 × 10-9 mm Hg at 25°C) and a low Henry's law constant (1.50E-09 at 25°C). The physical-chemical properties suggest that abamectin is not likely to volatilize from moist soil or water surfaces under field conditions. Abamectin has a low potential for transport in the atmosphere. Abamectin is not expected to bioaccumulate in biota (log K_{ow} of 4.4 at pH 7.2).

In the terrestrial environment, abamectin is non-persistent to moderately persistent in soil. Under laboratory conditions, four major transformation products were identified: 8a-oxo-avermectin B1a (NOA 448111), 8a-hydroxy-avermectin B1a (NOA 448112), 4,8a-dihydroxy-avermectin B1a (NOA457464) and 4-hydroxy-8a-oxo-avermectin B1a (NOA 457465). Aerobic biotransformation in soil is the most significant route of dissipation (DT_{50} values of 10.2 to 59.4 days). Under field conditions, abamectin is non-persistent to slightly persistent in soil (DT_{50} values of 0.1 to 24.8 days) and has a low potential to be carried over to the following growing season.

Laboratory experiments show that abamectin is immobile in most soils (K_{oc} values ranged between 5905 and 7586 L/kg). Observations from field dissipation studies indicate that abamectin was confined to the top 15 cm layer. Abamectin is not likely to leach through the soil and reach groundwater. Laboratory experiments conducted with transformation products show they have slight or low mobility (K_{oc} ranged from 1082 to 5813 L/kg).

In the aquatic environment, abamectin is moderately persistent to persistent. Laboratory studies indicate aqueous photolysis and aerobic/anaerobic biotransformation contribute to the overall dissipation of abamectin. Four major transformation products were identified in aquatic systems: 8a-oxo-avermectin B1a (NOA 448111), 8a-hydroxy-avermectin B1a (NOA 448112), 4"-oxo-avermectin B1a (NOA 426289) and 3"-demethylavermectin B1a (NOA 445495). In aerobic aquatic systems, abamectin dissipated by partitioning rapidly from the water phase to the sediment where it remains moderately persistent in the total system (DT_{50} value of 86.9–91.3 days). In anaerobic aquatic systems, abamectin also partitioned to the sediment and was persistent in the total system (DT_{50} value of 229.6–311.6 days).

4.2 Environmental risk characterization

The environmental risk assessment integrates the environmental exposure and ecotoxicology information to estimate the potential for adverse effects on non-target species. This integration is achieved by comparing exposure concentrations with concentrations at which adverse effects occur. Estimated environmental concentrations are concentrations of pesticide in various environmental media, such as food, water, soil and air. The EECs are estimated using models which take into consideration the application rate(s), chemical properties and environmental fate properties, including the dissipation of the pesticide between applications. Ecotoxicology information includes acute and chronic toxicity data for various organisms or groups of organisms from both terrestrial and aquatic habitats including invertebrates, vertebrates, and plants. To characterise acute risks, acute toxicity endpoints (such as LC_{50}, LD_{50}, or EC_{50}) are used, and the NOEC or NOEL values are used to characterize chronic risks. Toxicity endpoints used in risk assessments are adjusted to account for potential differences in species sensitivity as well as varying protection goals (in other words, protection at the community, population, or individual level). Where possible analysis of toxicity data includes the determination of the hazardous concentration to five percent of species (HC_5) from species sensitivity distributions (SSDs) or determination of the most sensitive endpoint in each taxonomic group and category. The HC_5 is the concentration which is assumed to be protective of 95% of species of the assessed taxonomic group.

The risk assessment is conducted in a tiered approach. Initially, a screening level risk assessment is performed to identify pesticides and/or specific uses that do not pose a risk to non-target organisms, and to identify those groups of organisms for which there may be a potential risk. The screening level risk assessment uses simple methods, conservative exposure scenarios (for example, direct application at a maximum cumulative application rate) and the most sensitive toxicity endpoints. A risk quotient (RQ) is calculated by dividing the exposure estimate by an appropriate toxicity value (RQ = exposure/toxicity), and the RQ is then compared to the level of concern (LOC=1 for most species, 0.4 for acute risk to pollinators, and 2 for glass plate studies, using the standard beneficial arthropod test species (*Typhlodromus pyri,* and *Aphidius rhopalosiphi*). If the screening level RQ is below the level of concern, the risk is considered negligible, and no further risk characterization is necessary. If the screening level RQ is equal to or greater than the LOC, then a refined risk assessment is performed to further characterize the risk. A refined assessment takes into consideration more realistic exposure scenarios (such as drift to non-target habitats) and might consider different toxicity endpoints. Refinements may include further characterization of risk based on exposure modelling, monitoring data, results from field or mesocosm studies, and probabilistic risk assessment methods. Refinements to the risk assessment may continue until the risk is adequately characterized or no further refinements are possible.

The environmental risk assessment was conducted based on the maximum cumulative application rate on outdoor ornamentals and single minimum application rate on pear for both groundboom and airblast application methods, using fine ASAE spray quality.

A summary of ecotoxicity endpoints is presented in Appendix IX, Tables 4 and 5. The most sensitive endpoints for each taxa were chosen as surrogates for the screening level assessment.

4.2.1 Risks to terrestrial organisms

At the screening level, risks were acceptable for earthworms and soil dwelling arthropods (Appendix IX, Table 6).

Pollinators: Foraging bees could be exposed directly to abamectin spray droplets during application or to abamectin residues found on the surface of leaves (contact exposure). Foraging bees could also be exposed to abamectin through the ingestion of pollen and nectar contaminated from direct spray (oral exposure). In addition, brood may be exposed to abamectin as foraging bees bring contaminated pollen and nectar back to the hive. At the screening level, the LOC for risk to pollinators was exceeded (RQ values of 68.6–34 755) (Appendix IX, Table 6).

A tier 1 refined risk assessment was conducted using residues in pollen and nectar collected from bees, flowers and leaves available from a semi-field study (application rate of 25.85 g a.i./ha on full-flowering *Phacelia*) and comparing them to Tier 1 endpoints for adult bees and larva. The resulting RQ values (5.5–198) still exceed the LOC (Appendix IX, Table 7).

A tier II semi-field study (25.85 g a.i./ha) and tier III field study (21.6 g a.i./ha) applied abamectin in the evening on full flowering bee-attractive plants *Phacelia tanacetifoli*. Only transitory effects on honeybee mortality (0–2 days) and foraging activity (0–6 days) were observed on treated fields compared to the control. No treatment related effects were observed on overall conditions of the colony. Detailed analysis of brood development indicated effects on old larvae from day 28 to the end of the semi-field study (62 days), but these effects were not reflected in the overall colony strength in the treated fields compared to the control. In the field study, a slight repellent effect was observed from Day 1 to Day 4.

Overall, available data indicate that there is a potential risk to pollinators from foraging on crops treated with abamectin. Reported incidents on the United States Ecological Incident Information System (US EIIS) validate these observations. Bee mortality in 32 hives, 400 hives, and 100 colonies was reported in three incidents.

To mitigate risks to pollinators, application to bee attractive crops will be restricted during the bloom period and spray drift to habitats close to application sites will be minimized. With the proposed mitigation, risks to pollinators are considered acceptable.

Beneficial predatory and parasitic arthropods: Foliar dwelling predatory mites and parasitoids may be exposed to residues of abamectin on-field at the site of application and off-field. At the screening level, the LOC was exceeded both on-field and off-field (RQ up to 392.2) (Appendix IX, Table 6).

The risks to beneficial arthropods were further characterized by considering the 3-dimensional structure where a certain fraction is intercepted by the crop (for on-field exposure) or the off-field vegetation (for off-field exposure). For on-field exposure, crop-specific foliar interception factors were applied to the EEC. For off-field exposure, a vegetation distribution factor (0.1) was applied to the application drift expected from each application method. Results are presented in Appendix IX, Table 8. The LOC was exceeded on-field and off-field for ground and airblast applications at the maximum cumulative rate (RQ values up to 156.9) and at the single minimum rate (RQ values up to 39.5). These results are consistent with available residue data from laboratory and semi-field studies, which indicate that fresh residues of abamectin cause adverse effects (mortality and reproduction) on predatory mite *T. pyri* and parasitoid wasp *A. rhopalosiphi* at rates an order of magnitude lower than those currently registered in Canada. The data indicates that adverse effects are minimised with aging of the residues and there is potential for recovery.

Overall, there are potential risks to beneficial arthropods, particularly from exposure to fresh residues of abamectin. Based on available residue data, effects are likely to be minimized after aging of residues and recolonization to normal population size is expected within a year. Label statements advising of the toxicity and encouraging drift reduction to non-target sites are required on the product labels. With the proposed mitigation, the risks are considered acceptable.

Birds: At the screening level, with the exception of acute effects on large birds, the LOC was exceeded (RQ values up to 6.5) (Appendix IX, Table 9). Further characterization of the risks using mean monogram residues resulted in the LOC being exceeded in some instances both on-field (RQ values up to 4.5) and off-field (RQ values up to 3.33) (Appendix I, Table 10). A label statement is required to inform users of the potential hazard to birds.

Mammals: At the screening level, the LOC was exceeded (RQ values up to 42.4) (Appendix IX, Table 9). Further characterization of the risk using LOEL endpoints and mean monogram residues resulted in the LOC being exceeded in some instances both on-field (RQ values up to 4.53) and off-field (RQ values up to 3.35) (Appendix IX, Tables 11 to 13). There were no incident reports showing a causal link to abamectin. A label statement is required to inform the user of the potential hazard to mammals.

Terrestrial plants: At the screening level, risks to non-target terrestrial plants slightly exceeded the level of concern (<1.13) (Appendix IX, Table 6). The assessment is based on a non-dose response effect observed in a study. The United States incident reporting database (US EIIS) identifies cases of plant damage for some crops treated with abamectin. At the currently registered rates, the use of spray buffer zones would be needed to protect non-target plants. Based on the reduced rates needed to mitigate risks from runoff, terrestrial buffer zones would not be required.

4.2.2 Risks to aquatic organisms

Limited information is available on the toxicity of abamectin transformation products to aquatic organisms. Freshwater invertebrates and fish were shown to be far less sensitive to abamectin transformation products (such as NOA 448111, NOA 448112 and NOA 426289) as compared to abamectin. As a result, the aquatic risk assessment is based on toxicity and exposure to abamectin only.

Sufficient acute toxicity data were available to determine the HC_5 value (the 5th percentile of the species sensitivity distribution (SSD) of the LC_{50} at 50% confidence intervals) for non-target freshwater invertebrates. The hazardous concentration to five percent of species (HC_5) was calculated from available LC_{50} values, using the software program ETX 2.1. A total of 14 acute toxicity endpoints for freshwater invertebrate species were used for SSD analysis. The median HC_5 value for abamectin for acute effects on freshwater invertebrates was determined to be 0.025 µg a.i./L (CI: 0.0015 to 0.144 µg a.i./L). The variability around the fraction of species affected (FA, expressed as a percentage of all species) indicates a range of 0.92–16.63%. Therefore, exposure to the median HC_5 value (0.025µg a.i./L) could result in adverse effects in a minimum of 0.92% of species and up to a maximum of 16.63% of all species at the EC_{50} level. This variability indicates that the 95% of species protection level may not always be achieved. A summary of the SSD analysis and the data used to determine the SSD are found in Appendix IX.

For the acute risk assessment for marine invertebrates, freshwater fish, marine fish and amphibians, the most sensitive LC_{50}'s were used. For the chronic assessment, the corresponding NOECs including those for freshwater invertebrates were used.

Screening level aquatic EECs were determined by assuming direct application to water at the maximum cumulative application rate on outdoor ornamentals using a DT_{50} value of 91.3 days (the longest of two aquatic whole system half-lives). Risk quotients did not exceed the level of concern for algae and aquatic plants but did exceed the level of concern (RQ values up to 6818) for acute and chronic effects for all other aquatic species (Appendix IX, Table 14).

The aquatic risk assessment was further characterized by considering potential risk from spray drift at the time of application and runoff.

Spray drift: Spray drift data were used to determine the maximum spray deposit into an aquatic habitat located 1m downwind from the application site during spraying, using the maximum cumulative application rate on outdoor ornamentals. For groundboom, a fine spray droplet size is used with a maximum drift of 11% of the applied. For airblast application, 74% (early application) and 59% (late application) drift is assumed. In marine/estuarine habitats, cumulative deposit from multiple applications and chronic exposure resulting from spray drift is not expected given the high rates of water replacement due to tidal flushing. For this reason, risk from spray drift is determined based on the acute effects metric and the EECs for the maximum single application rate only on pears at 28.6 g a.i./ha.

The risk quotients indicate that the LOC is exceeded for all freshwater organisms, for all crops and all application methods on an acute and chronic basis (RQ values up to 1354) (Appendix IX, Table 15). The LOC is also exceeded for estuarine/marine organisms based on acute exposure at the maximum single application rate, 1 m downwind from application (RQ values up to 265).

Spray buffer zones (up to 50 m for freshwater and up 45 m for marine habitats) are required to mitigate risks to aquatic organisms from spray drift.

Runoff

Modelling: Estimated environmental concentrations in aquatic habitats from runoff were calculated using the Pesticide in Water Calculator (PWC) model (version 1.52). Model input parameters for ecological modelling are presented in Appendix IX, Table 1. For ecological modelling, PWC calculates the amount of pesticide entering the water body by runoff alone, and the subsequent transformation of the pesticide in the water system. EECs are calculated by modelling a total land area of 10 ha draining into a 1 ha pond of two different depths (15 and 80 cm). The model is run for 50 years. The results of the ecological modelling are presented in Appendix IX, Table 2b.

To assess acute risks based on modelling, the 90th percentile of 24- or 96-hour EECs were compared against the acute effects metrics to generate acute RQ values. To assess chronic risks based on modelling, 21-day EECs were compared against the chronic effects metrics to generate chronic RQ values. The risk quotients from exposure to abamectin based on modelled runoff concentrations (RQ values up to 76 for freshwater organisms and up to 282 for marine organisms) are presented in Appendix IX, Table 16.

Water monitoring: A search for water monitoring data on abamectin, in groundwater and surface water from Canada or the United States, was undertaken as part of this review. Monitoring data were not available for abamectin. As a result, exposure concentrations could not be estimated based on water monitoring data.

Aquatic incident reports: The USEPA's Ecological Incident Information System (EIIS) database reports two cases of runoff of abamectin that resulted in the deaths of substantial number of catfish and other fish.

Aquatic risk assessment conclusion based on current conditions of use: The aquatic risk assessment indicates that under current conditions of use, aquatic organisms are potentially at risk from exposure to runoff and mitigation measures are required.

Runoff mitigation proposal: Reducing rates to a maximum cumulative application of 38 g a.i./ha was examined. Water modelling was conducted with only 2 applications at 19 g a.i./ha (7-day application interval). The maximum RQ values (reported in Appendix 1, Table 16) were reduced, but were still considered to pose potential risks to aquatic organisms (freshwater acute RQ up to 19.2, freshwater chronic RQ up to 20.7, marine acute RQ up to 43.6, marine chronic RQ up to 77).

The risk assessment was further characterized by including the use of a mandatory 10 m wide vegetative filter strip (VFS) as a mitigation tool to reduce concentrations of abamectin entering aquatic habitats through runoff. The environmental fate properties of abamectin (low solubility, high adsorption, high toxicity to aquatic organisms) indicate that a VFS may help mitigate risks associated with runoff.

For the assessment of abamectin, an in-development (beta) PWC-VFSMOD coupling (VFSMOD v.4.4.3, PWC v1.52) was used to simulate reductions in EECs provided by a 10 m wide VFS. This modelling was conducted using the reduced rate of 2 applications at 19 g a.i./ha (7-day application interval). The model indicates exposure from runoff is reduced by approximately 30% (acute) and 45% (chronic) with the addition of a 10 m wide VFS. The resulting maximum RQ values (reported in Appendix IX, Table 16) were further reduced (freshwater acute RQ up to 12.8, freshwater chronic RQ up to 11, marine acute RQ up to 29.1, marine chronic RQ up to 4).

Modelling requires a number of conservative assumptions that include but are not limited to i) assuming the user applies the pesticide in question annually for a 50-year period, ii) application is to 100% of the cropped area, iii) surface water runoff enters a waterbody with no outflow which causes the pesticide to accumulate, and iv) selection of the 90th percentile of the distribution of maximum 21-d yearly averages. The models are not designed to take into account factors that may limit surface water runoff such as interception by crop foliage during application that limits deposition of the pesticide onto soil surfaces, or a runoff event might not occur immediately after application. These conservative assumptions and limitations are reflected in the modelled water concentration and resulting risk estimate.

With applications reduced to a maximum cumulative amount of 38 g a.i./ha per season and the addition of a mandatory 10 m vegetative filter strip, risks to aquatic organisms from surface water runoff are considered to be acceptable.

4.2.3 Environmental incident reports

As of 2 August 2022, no environmental incidents have been submitted to the PMRA for abamectin. The USEPA Ecological Incident Information System (US EIIS) contains 15 incidents. One incident of bee mortality and one incident of butterfly mortality were considered unlikely to be related to abamectin. The remaining incidents were considered to be at least possibly related to abamectin. Two cases of runoff resulted in the death of 100 catfish and “tons of dead” unknown fish.

Plant damage was reported in almond, apple, corn and grape crops, with 6 to 285 acres displaying damage after treatment with abamectin. Bee mortality in 32 hives, 400 hives, and 100 colonies was reported in three incidents.

The information from the available incident reports is consistent with the known toxicity hazard of abamectin to fish and bees. The reduction in the maximum cumulative application rate, the requirement for a 10 m VFS, revised spray buffer zones, additional mitigation requirements for bees and required hazard statements are expected to reduce exposure to non-target organisms.

4.2.4 Environmental risk conclusions

Terrestrial organisms: Risks to earthworms and soil dwelling invertebrates are acceptable. Potential risks to pollinators can be mitigated by prohibiting application to highly attractive crops during crop bloom and avoiding application when bees are active. Hazard statements are required to inform users of the toxicity of abamectin to bees, beneficial arthropods, birds and mammals. As indicated below, the cumulative rate of application is proposed to be reduced to mitigate the risk to aquatic organisms. Based on this proposed reduced rate needed to mitigate risks from runoff, terrestrial spray buffer zones would not be required.

Aquatic organisms: Hazard statements are required on labels to inform users of the toxicity of abamectin to aquatic organisms. Aquatic spray buffer zones are required to mitigate risk to aquatic organisms associated with pesticide drift at the time of application. To mitigate risks associated with runoff, the maximum cumulative application rate must be reduced to 38 g a.i./ha and a 10 m vegetative filter strip must be constructed and maintained between the field edge and adjacent, downhill aquatic habitat. Effluent containing abamectin must not be released to aquatic habitats from greenhouses.

The reduction in the maximum cumulative application rate to 38 g a.i./ha results in changes to both the terrestrial and aquatic risk assessments. The LOC for beneficial predatory and parasitic arthropods is still exceeded on-field (RQ 86.3) and off-field (RQ 16) and precautionary label statement are still required. The LOC is still exceeded for birds and mammals on-field (RQ up to 2.5) and off-field (RQ up to 1.8) and precautionary label statements are still required. Risks to terrestrial plants are considered acceptable, thereby eliminating the need for a hazard statement and spray buffer zones for the protection of terrestrial plants. Mitigation of risks to aquatic organisms associated with spray drift still requires aquatic buffer zones of up to 50m (freshwater) and 45m (marine). In addition, mitigation of risks to aquatic organisms from the runoff requires the mandatory construction and maintenance of a 10 m vegetative filter strip between the field edge and adjacent, downhill aquatic habitat.

4.3 Assessment of abamectin under the toxic substances management policy considerations

The Toxic Substances Management Policy (TSMP) is a federal government policy developed to provide direction on the management of substances of concern that are released into the environment. The TSMP calls for the virtual elimination of Track 1 substances, in other words, those that meet all four criteria outlined in the policy: persistent (in air, soil, water and/or sediment), bio-accumulative, primarily a result of human activity and toxic as defined by the *Canadian Environmental Protection Act*. The *Pest Control Products Act* requires that the TSMP be given effect in evaluating the risks of a product. During the review process, abamectin and its transformation products were assessed in accordance with the PMRA Regulatory Directive DIR99-03[1] and evaluated against the Track 1 criteria. The PMRA has reached the conclusion that abamectin and its transformation products do not meet all of the TSMP Track 1 criteria. Please refer to Table 17, Appendix IX for further information on the TSMP assessment.

4.3.1 Formulants and contaminants of health or environmental concern

During the review process, contaminants in the active ingredient as well as the formulants and contaminants in the end-use products are compared against Parts 1 and 3 of the *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern.*[3] The list is used as described in the Health Canada's Science Policy Note SPN2020-01[4] and is based on existing policies and regulations including the Toxic Substances Management Policy and Formulants Policy, and taking into consideration the Ozone-depleting Substances and Halocarbon Alternatives Regulations under the *Canadian Environmental Protection Act*, 1999 (substances designated under the Montreal Protocol). Health Canada has reached the following conclusions:

Health Canada has reached the conclusion that abamectin and its end-use products do not contain any formulants or contaminants identified in the *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern*.

The use of formulants in registered pest control products is assessed on an ongoing basis through PMRA formulant initiatives and Regulatory Directive DIR2006-02.

5.0 Value assessment

Abamectin is an acaracide/insecticide registered for use on a wide-range of outdoor field-grown fruit and vegetable crops, outdoor ornamentals, greenhouse vegetables and greenhouse ornamentals for the control or suppression of a variety of agricultural pests such as mites, sawflies, moths, thrips, leafminers, psyllids, aphids and certain beetles. It is also registered for commercial and domestic indoor and/or outdoor structural use to control cockroaches and ants. It is valuable to both the agricultural crop production and structural sectors for resistance management because it is the only MOA Group 6 active ingredient registered.

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3 SI/2005-114, last amended on June 24, 2020. See Justice Laws website, Consolidated Regulations, *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern*.

4 PMRA's Science Policy Note SPN2020-01, *Policy on the List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern* under paragraph 43(5)(b) of the *Pest Control Products Act*

List of abbreviations

µg	micrograms
µL	microlitre
µm	micrometer
1/n	exponent for the Freundlich isotherm
ABM	abamectin
a.i.	active ingredient
AR	applied radioactivity
a.s	active substance
ADI	acceptable daily intake
ARfD	acute reference dose
ARTF	Agricultural Re-entry Task Force
ASAE	American Society of Agricultural and Biological Engineers
atm	atmosphere
BAF	bioaccumulation Factor
BCF	bioconcentration Factor
bw	body weight
CAF	composite assessment factor
CAS	chemical abstracts service
CEPA	Canadian Environmental Protection Act
CFIA	Canadian Food Inspection Agency
CI	Confidence Interval
cm	centimetres
cm^2	centimeter squared
cm^2/hr	centimeters squared per hour
CO^2	carbon dioxide
CR	chemical resistant
DA	dermal absorption
DEEM	Dietary Exposure Evaluation Model
DFOP	double first order in parallel
DFR	dislodgeable foliar residue
DIR	directive
DT_{50}	dissipation time 50% (the time required to observe a 50% decline in concentration)
DT_{90}	dissipation time 90% (the time required to observe a 90% decline in concentration)
dw	dry weight
EbC50	effective concentration on 50% of the biomass
EC_{05}	effective concentration on 5% of the population
EC_{10}	effective concentration on 10% of the population
EC_{25}	effective concentration on 25% of the population
EC_{50}	effective concentration on 25% of the population
EC	emulsifiable concentrate
EDE	estimated daily exposure
EEC	estimated environmental concentration
EFSA	European Food Safety Authority
ER_{25}	effective rate on 25% of the population

ER_{50}	effective rate on 50% of the population
ErC_{50}	effective concentration which results in 50% reduction of growth rate
EyC50	effective concentration which results in 50% reduction of yield
FC	food consumption
FCID™	Food Commodity Intake Database™
FIR	food ingestion rate
g	gram
GUS	groundwater ubiquity score
ha	hectare(s)
HC_5	hazardous concentration for 5% of species
HH AB/MB	Handheld Airblast/Mistblower
HPLC	high performance liquid chromatography
hr	hours
IORE	Indeterminate Order Rate Equation (IORE)
IUPAC	International Union of Pure and Applied Chemistry
J	Joules
kg	kilogram
kPa	kilopascal
K_d	soil-water partition coefficient
K_F	Freundlich adsorption coefficient
K_{oc}	organic-carbon partition coefficient
K_{ow}	octanol-water partition coefficient
L	litre(s)
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
LOAEL	lowest observed adverse effect level
LOC	level of concern
LOEC	lowest observed effect concentration
LOED	lowest observed effect dose
LOEL	lowest observed effect level
LOD	limit of detection
LOQ	limit of quantitation
LR_{50}	lethal rate to 50%
M	meter
M/L/A	Mixer/Loader/Applicator
m^3	cubic meter
max	maximum
mg	milligram
min	minutes
mL	millilitre
mm Hg	millilitre of mercury
mol	mole
MOE	margin of exposure
MPHG	mechanically pressurized handgun
MPHW	manually pressurized handwand
MRL	maximum residue limits
MS	mass spectrometry
mV	millivolts

MW	Molecular weight
NA	Not available
N/A	not applicable
NER	Non extractable residues
NHANES	National Health and Nutrition Examination Survey
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOED	no observed effect dose
NOEL	no observed effect level
N/R	not required
NY	New York
O2	Oxygen
OC	organic carbon
OECD	Organisation for Economic Co-operation and Development
OM	organic matter
Pa	Pascal
p*K*a	dissociation constant
PCO	pest control operator
PCP	pest control product
PCPA	Pest Control Products Act
PDP	Pesticide Data Program
PHED	Pesticide Handlers Exposure Database
PHI	pre-harvest interval
PMRA	Pest Management Regulatory Agency
Ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
PWC	pesticide in water calculator
q_1*	cancer potency factor
REI	restricted-entry interval
RSD	relative standard deviation
RT_{25}	residual time to 25% bee mortality
RQ	risk quotient
SFO	single first order
SOP	standard operating procedures
SPN	science policy note
SSD	species sensitivity distribution
SU	suspension
$t_{1/2}$	half-life
TC	transfer coefficient
TRR	total radioactive residue
TSMP	Toxic Substances Management Policy
TTR	turf transferable residue
USDA	US Department of Agriculture
US EIIS	US Ecological Incident Information System
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VFS	vegetative field strip

v/v	volume per volume dilution
w	week
WP	wettable powder
w/v	weight per volume
w/w	weight per weight
WWEIA	What We Eat in America

Appendix I Registered products containing abamectin in Canada[1]

Table 1 Products containing abamectin subject to proposed label amendments

Registration number	Marketing class	Registrant	Product name	Formulation type	Active ingredient (%, g/L)
24484	Technical grade active ingredient	Syngenta Canada Inc.	Abamectin Technical	Dust or powder	Abamectin 92.1%
26896	Commercial	BASF Canada Inc.	Prescription Treatment Brand Avert Cockroach Bait Stations	Solid	Abamectin 0.05%
27864	Commercial	BASF Canada Inc.	Prescription Treatment Brand Avert Granular Carpenter Ant Bait	Granular	Abamectin 0.011%
27897	Commercial	BASF Canada Inc.	Prescription Treatment Brand Avert 360a Dual Choice Ant Bait Station	Paste	Abamectin 0.011%
28403	Commercial	BASF Canada Inc.	Prescription Treatment Brand Avert Dry Flowable Cockroach Bait	Dry flowable	Abamectin 0.05%
24485	Commercial	Syngenta Canada Inc.	Avid 1.9% EC Miticide Insecticide	Emulsifiable concentrate or emulsion	Abamectin 19 g/L
24551	Commercial	Syngenta Canada Inc.	Agri-Mek 1.9% EC Insecticide/Miticide	Emulsifiable concentrate or emulsion	Abamectin 19 g/L
31607	Commercial	Syngenta Canada Inc.	Agri-Mek SC	Suspension	Abamectin 84 g/L
33023	Commercial	Syngenta Canada Inc.	Minecto Pro	Suspension	Cyantraniliprole 135 g/L Abamectin 28.5 g/L
26645	Domestic	S. C. Johnson And Son, Limited	Raid Max Roach Bait	Solid	Abamectin 0.05%

Registration number	Marketing class	Registrant	Product name	Formulation type	Active ingredient (%, g/L)
27249	Domestic	S. C. Johnson And Son, Limited	Raid Max Ant Baits	Solid	Abamectin 0.05%
27250	Domestic	S. C. Johnson And Son, Limited	Raid Ant Baits 3	Solid	Abamectin 0.05%
27731	Domestic	S. C. Johnson And Son, Limited	Raid Double Control Roach Baits	Solid	Abamectin 0.05%
27761	Domestic	S. C. Johnson And Son, Limited	Raid Double Control Ant Baits 2	Solid	Abamectin 0.05%
28347	Domestic	S. C. Johnson And Son, Limited	Raid Outdoor Ant Spikes	Solid	Abamectin 0.05%
30597	Domestic	S. C. Johnson And Son, Limited	Raid Max Double Control Ant Baits	Solid	Abamectin 0.05%
32316	Domestic	S. C. Johnson And Son, Limited	Raid Ant Baits 4	Solid	Abamectin 0.05%
32317	Domestic	S. C. Johnson And Son, Limited	Raid Max Double Control Ant Baits 2	Solid	Abamectin 0.05%
32318	Domestic	S. C. Johnson And Son, Limited	Raid Max Ant Baits 2	Solid	Abamectin 0.05%

[1] as of 26 August 2022, excluding discontinued products or products with a submission for discontinuation

Appendix II Registered uses of abamectin in Canada[1,2,3]

Table 1 Registered commercial uses of abamectin in Canada

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
Use-site category 5 – Greenhouse Food Crops							
Greenhouse peppers	two-spotted spider mite, tomato psyllid	Emulsifiable concentrate	[vertical boom sprayer (high-volume sprayer), robotics, or backpack/spot spray]	[22.8]	114 per crop cycle	(5 per year) • 5 per crop cycle • [1 crop cycle per year]	[7]
Greenhouse cucumbers	two-spotted spider mite, leafminers	Emulsifiable concentrate	[vertical boom sprayer (high-volume sprayer), robotics, or backpack/spot spray]	[22.8]	114 per crop cycle	(20 per year) • 5 per crop cycle • [4 crop cycles per year]	[7]
Greenhouse tomatoes	two-spotted spider mite, tomato psyllid, leafminers	Emulsifiable concentrate	[vertical boom sprayer (high-volume sprayer), robotics, or backpack/spot spray]	[22.8]	45.6 per crop cycle	[4 per year] • [2 per crop cycle] • [2 crop cycles per year]	[7]
Use-site category 6 – Greenhouse Non-Food Crops							
Greenhouse ornamentals	spider mites, leafminers	Emulsifiable concentrate	[vertical boom sprayer (high-volume sprayer), robotics, or backpack/spot spray]	[22.8]	[114 per crop cycle]	[15 per year] • [5 per crop cycle] • [3 crops of ornamentals per year is typical]	[7]
Use-site category 14 – Terrestrial Food Crops							
Bulb onion sub-group Crop group 3-07A[4]	onion thrips	Emulsifiable concentrate Suspension	[Ground application equipment]	22.8	68.4	3	7

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
Caneberries Subgroup 13-07A[5]	two-spotted spider mites	Emulsifiable concentrate Suspension	[Field sprayer (ground application)]	19	57	Do not apply more than 3 pre-harvest applications and more than 2 post-harvest applications per growing season.	7
Celery	pea leafminers	Emulsifiable concentrate Suspension	[Field sprayer (ground application)]	21	84	4	7
Grapes	spider mites including: two-spotted spider mites and European red mites	Emulsifiable concentrate Suspension	[Ground application (field sprayer or airblast)]	22.3	44.5	2	21
Green onion Subgroup 3-07B[6]	onion thrips	Emulsifiable concentrate Suspension	[Field sprayer (ground application)]	22.8	91.2	4	7
Hops	spider mites, including two-spotted spider mite	Emulsifiable concentrate Suspension	[Ground application (field sprayer or airblast)]	21	42	2	21
Strawberries	Cyclamen mite, two-spotted spider mite, McDaniel spider mite	Emulsifiable concentrate Suspension	[Ground application (field sprayer)]	19	38	2	[7]
Use-site category 13/14 – Terrestrial Feed/Food Crops							
Apples	two-spotted spider mite, McDaniel mite, European red mite, spotted tentiform	Emulsifiable concentrate Suspension	[Ground-airblast]	14.3	14.3	1	Not applicable

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
	leafminer, Western tentiform leafminer, codling moth, Oriental fruit moth, oblique-banded leafroller, three-lined leafroller, fruittree leafroller, European leafroller, eyespotted bud moth, tufted apple bud moth, European apple sawfly						
Pears	two-spotted spider mite, McDaniel mite, European red mite, pear rust mite, yellow mite, pear psylla, codling moth, Oriental fruit moth, spotted tentiform leafminer, Western tentiform leafminer, oblique-banded leafroller, three-lined leafroller, fruittree leafroller,	Emulsifiable concentrate Suspension	[Application equipment is (Ground-airblast)]	28.6	28.6	• 2 at the minimum rate • 1 at the maximum rate	10

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
	European leafroller, eyespotted bud moth, tufted apple bud moth, European apple sawfly, green peach aphid, rosy apple aphid, white apple leafhopper, apple maggot, plum curculio, Japanese beetle						
Potatoes	spider mite (including two-spotted spider mite), potato psyllid, Colorado potato beetle, European corn borer, flea beetle	Emulsifiable concentrate Suspension	[Ground application (field sprayer)]	19.1	38.2	• 3 at the minimum rate • 2 at the maximum rate	7
Celeriac	two-spotted spider mite, flea beetle	Suspension	(Ground - field sprayer)	21.1	42.2	2	7
Cucurbit Vegetables (Crop group 9)[7]	cabbage looper, armyworm, fall armyworm, cutworm, spider mites, corn earworm	Suspension	(Ground - field sprayer)	19.1	57.3	• 5 at the minimum rate • 3 at the maximum rate	7

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
Fruiting Vegetables (Crop group 8-09)[8]	cabbage looper, armyworm, beet armyworm, fall armyworm, cutworm, European corn borer, *Liriomyza* leafminers, flea beetle, broad mite, spider mites, tomato russet mite, tomato psyllid, tomato fruitworm (corn earworm), suppression of tobacco hornworm, suppression of tomato hornworm, Colorado potato beetle	Suspension	(Ground - field sprayer)	21.1	63.4	• 5 at the minimum rate • 3 at the maximum rate	7
Leafy Greens (Crop subgroup 4-13A)[9]	cabbage looper, armyworm, beet armyworm, fall armyworm, cutworm, Carmine spider mite, two-spotted spider mite, corn earworm	Suspension	(Ground - field sprayer)	19.1	57.3	• 5 at the minimum rate • 3 at the maximum rate	7
Leaf Petioles (Crop subgroup 22B)[10]	cabbage looper, armyworm, beet armyworm,	Suspension	(Ground - field sprayer)	21.1	63.4	• 6 at the minimum rate • 3 at the maximum	7

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
	fall armyworm, cutworm, pea leafminers, corn earworm, Carmine spider mite, two-spotted spider mite					rate	
Tuberous and Corm Vegetables (Crop subgroup 1C)[11]	cabbage looper, armyworm, beet armyworm, fall armyworm, variegated cutworm, European corn borer, spider mites, flea beetle, corn earworm, suppression of tobacco hornworm, suppression of tomato hornworm	Suspension	(Ground - field sprayer)	19.1	38.2	• 3 at the minimum rate • 2 at the maximum rate	7 days
Use-site category 20 – Structural							
Indoor and outdoor: Residential and Non-residential Structures (including food handling facilities and modes of transport)	Cockroaches	Solid	Bait station	0.0009 g/m^2	0.011 g/m^2 per year	[12 (1/ month)]	[Approximately every 3 months] (1 month)

Site	Pests	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
Indoor and outdoor: Residential and Non-residential Structures (including food handling facilities and modes of transport)	Ants (including Pharoah and Carpenter)	Granular	Indoor: Appropriate application device to place the product into crevices or voids. Child resistant bait stations. Outdoor: Child resistant bait stations that are secured in place.	Indoor: [0.0102 g a.i./m] Outdoor: [42.5 g a.i./ant colony] (0.0044 g a.i./m^2)	Indoor: 0.122 g a.i./m per year Outdoor: (0.0528 g a.i./m^2)	[12]	[1 (month)] [Typical is 3 months, however it can be 1 month]
Indoor: Residential and Non-residential Structures (including Food Handling Facilities) and Modes of Transport)	Ants (including Pharoah and Carpenter)	Paste	Bait station	[0.011 g a.i. / house]	0.132 g a.i./house per year	[12]	[1 month]
Indoor: Residential and Non-residential Structures (including Food Handling Facilities) and Modes of Transport)	Cockroaches	Dry Flowable	Indoor: Appropriate application device to place the product into crevices or voids.	[0.0002 g a.i./ m^2]	0.0024 g a.i./m^2	[12]	[1 month]

[1] as of 29 August 2022, excluding discontinued products or products with a submission for discontinuation

[2]All information is derived from registered product labels, except for information provided by registrants which is indicated by [ ], and data calculated by the PMRA which is indicated by ( ).

[3]Since the initiation of the re-evaluation of abamectin, the following use pattern expansions have been registered:

- addition of use on outdoor ornamentals and boxwood, for the control of leafminers and boxwood psyllid respectively, to the Avid 1.9% EC Miticide label (24485) - (Category C.6.3 submission 2019-1016; Evaluation Report PMRA# 3024876);
- addition of use on Bulb Vegetables (Crop Group 3-07) for control of thrips and leafminer. The group is comprised of the following crops: bulb garlic, great-headed bulb garlic, leek, bulb onion, green

onion, Welsh onion tops, bulb shallot, fresh leaves shallot, potato bulb onion, Chinese bulb onion, tree onion tops, fresh leaves chives, Chinese fresh leaves chives, bulb daylily, hosta elegans, fritillaria, serpent bulb garlic, kurrat, lady's leek, lily, Beltsville bunching onion, fresh onion, macrostem onion, pearl onion and wild leek. **Note that:** the crops within this group are currently registered within crop cub-groups 3-07A or 3-07B at the same rates.

[4]Bulb Onions (Crop Subgroup 3-07A): bulb daylily, fritillaria, bulb garlic, great-headed bulb garlic, serpent bulb garlic, lily, bulb onion,
Chinese bulb onion, pearl onion, potato bulb onion, bulb shallot

[5]Caneberries (Crop Subgroup 13-07A): blackberry, loganberry, black and red raspberry, wild raspberry and cultivars, varieties and/or hybrids of these

[6]Green Onions (Crop Subgroup 3-07B): Chinese fresh leaves chives, fresh leaves chives, hosta elegans, fritillaria, kurrat, lady's leek, leek, Beltsville bunching onion, fresh onion, green onion, macrostem onion, tree onion tops, Welsh onion tops, fresh leaves shallot and wild leek

[7]Cucurbit Vegetables (Crop Group 9): Cucumber (including gerkins), Gourd (Chinese waxgourd/Chinese preserving melon and edible gourds including hyotan, cucuzza, hechima and Chinese okra), Melons (citron, muskmelon including true cantaloupe, cantaloupe, casaba, crenshaw, golden pershaw, honeydew, honey balls, mango, Persian, pineapple, Santa Claus and snake, watermelon), Momordica spp. (including balsam apple, balsam pear, bitter melon, Chinese cucumber), pumpkin and Squash including summer (including crookneck, scallop, straightneck squash, vegetable marrow, and zucchini) and winter (including butternut, calabaza, hubbard, acorn, and spaghetti)

[8]Fruiting Vegetables (Crop Group 8-09): eggplant (including African, pea and scarlet), garden huckleberry, goji berry, groundcherry, martynia, okra, pea eggplant (pea and scarlet), pepino, pepper (bell and non-bell), sunberry, tomatillo, tomato (including currant)

[9]Leafy Greens (Crop Subgroup 4-13A): Chinese amaranth, leafy amaranth, Indian aster, blackjack, cat's whiskers, cham-chwi, cham-na-mul, chervil (fresh leaves), chipilin, garland chrysanthemum, cilantro (fresh leaves), corn salad, cosmos, dandelion, dang-gwi, dillweed (fresh leaves), dock, dol-nam-mul, ebolo, endive, escarole, fameflower, feather cockscomb, good King Henry, huauzontle, jute leaves, lettuce (bitter, head, leaf, Romaine). orach, parsley (fresh leaves), buckhorn plantain, English primrose, purslane (garden, winter), radicchio (red chicory), spinach (including Malabar, New Zealand, tree, tanier), Swiss chard, Chinese violet

[10]Leaf Petioles (Crop Subgroup 22B): cardoon, celery (including Chinese), fuki, rhubarb, udo and zuiki

[11]Tuberous and Corm Vegetables (Crop Subgroup 1C): arracacha, arrowroot, Chinese artichoke, Jerusalem artichoke, edible canna, chufa, dasheen (taro), sweet potato, true yam

Table 2 Registered domestic uses of abamectin in Canada[1,2]

Site	Pest(s)	Formulations	Application method and equipment	Maximum single application rate (g a.i./ha)	Maximum cumulative application rate per year	Maximum number of applications per year	Minimum interval between applications (Days)
Use-site category 20 – Structural							
Indoor	Cockroaches	Solid	Bait stations	0.012 g a.i. / kitchen 0.0032 g a.i. / bathroom (when stated)	0.048 g a.i. / kitchen per year 0.0128 g a.i. / bathroom per year (when stated)	[4]	[3 months]

Indoor/ Outdoor	Ants	Solid	Bait stations	Indoor: 0.013 g a.i. / kitchen 0.0034 g a.i. / bathroom (when stated) Outdoor: 0.0045 g a.i. / 1.5 m (when stated)	Indoor: 0.052 g a.i. / kitchen per year 0.014 g a.i. / bathroom per year (when stated) Outdoor: 0.018 g a.i. / 1.5 m (when stated)	[4]	[3 months]

[1] As of 29 August 2022, excluding discontinued products or products with a submission for discontinuation
[2]All information is derived from registered product labels, except for information provided by registrants which is indicated by [ ], and data calculated by the PMRA which is indicated by ( ).

Appendix III Toxicology information for health risk assessment

Table 1 Toxicology reference values for use in health risk assessment for abamectin

Exposure scenario	Study	Point of departure and endpoint	CAF[1] or Target MOE
Acute dietary general population	Acute neurotoxicity study in rats, supported by 12-week study in dogs	NOAEL = 0.5 mg/kg bw Based on decreased splay reflex in rats at 1.5 mg/kg bw and mydriasis observed in dogs at 1.0 mg/kg bw/day.	300
	ARfD = 0.0017 mg/kg bw		
Repeated dietary	Developmental neurotoxicity study	NOAEL = 0.12 mg/kg bw/day Based on decreased pup body weight at 0.2 mg/kg bw/day	300
	ADI = 0.0004 mg/kg bw/day		
Incidental oral (acute)	Acute neurotoxicity study in rats, supported by 12-week study in dogs.	NOAEL = 0.5 mg/kg bw Based on decreased splay reflex in rats at 1.5 mg/kg bw and mydriasis observed in dogs at 1.0 mg/kg bw/day.	300
Incidental oral (short-term), Aggregate	Developmental neurotoxicity study	NOAEL = 0.12 mg/kg bw/day Based on decreased pup body weight at 0.2 mg/kg bw/day	300
Dermal[2] and Inhalation[3] (all durations)	Developmental neurotoxicity	NOAEL = 0.12 mg/kg bw/day Based on decreased pup body weight at 0.2 mg/kg bw/day	300
Aggregate - All routes and durations of exposure	Developmental neurotoxicity study	NOAEL = 0.12 mg/kg bw/day Based on decreased pup body weight in the developmental neurotoxicity study at 0.2 mg/kg bw/day	300
Cancer	No evidence of carcinogenicity		

[1] CAF (composite assessment factor) refers to a total of uncertainty and PCPA factors for dietary assessment. MOE refers to a target MOE for occupational and residential assessments. Standard uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability were applied and a PCPA factor of threefold was considered appropriate. The CAF/MOE is thus 300.

[2] Since an oral NOAEL was selected, a dermal absorption factor of 1% was established from an *in vivo* monkey study.

[3] Since an oral NOAEL was selected an inhalation absorption factor of 100% (default value) was used in route-to-route extrapolation.

Appendix IV Dietary exposure and risk assessments

Table 1 Summary of acute deterministic dietary exposure and risk analyses for abamectin

Subpopulation	Food only – 95th Percentile		Food and drinking water[1] – 95th Percentile	
	Exposure (mg/kg bw)	%ARfD[2]	Exposure (mg/kg bw)	%ARfD[2]
General Population	0.000099	5.8	0.000211	12.4
All Infants (<1 year old)	0.000207	12.2	0.000524	30.8
Children 1–2 years old	0.000249	14.7	0.000379	22.3
Children 3–5 years old	0.000184	10.8	0.000288	17.0
Children 6–12 years old	0.000106	6.3	0.000205	12.1
Youth 13–19 years old	0.000066	3.9	0.000153	9.0
Adults 20–49 years old	0.000073	4.3	0.000187	11.0
Adults 50+ years old	0.000077	4.5	0.000168	9.9
Females 13–49 years old	0.000073	4.3	0.000191	11.3

[1]Estimated environmental concentrations (EECs) of abamectin in potential drinking water sources (groundwater and surface water) were modelled. The acute EEC used in this estimation is 2.5 µg/L (surface water, 90th percentile of 1-day concentrations from each year) modeled using the highest cumulative application rate (6 applications × 22.8 g a.i./ha).
[2]Acute Reference Dose (ARfD) of 0.0017 mg/kg bw.

Table 2 Summary of chronic dietary exposure and risk analyses for abamectin

Population subgroup	Food only		Food and drinking water[1]	
	Exposure (mg/kg bw/day)	%ADI[2]	Exposure (mg/kg bw/day)	%ADI[2]
General Population	0.000023	5.7	0.000041	10.3
All Infants (< 1 year old)	0.000050	12.4	0.000118	29.6
Children 1−2 years old	0.000079	19.9	0.000105	26.2
Children 3−5 years old	0.000053	13.2	0.000073	18.3
Children 6−12 years old	0.000028	7.0	0.000043	10.9
Youth 13−19 years old	0.000016	4.0	0.000029	7.2
Adults 20−49 years old	0.000018	4.5	0.000036	9.1
Adults 50+ years old	0.000019	4.7	0.000037	9.2
Females 13−49 years old	0.000017	4.3	0.000035	8.8

[1] Estimated environmental concentrations (EECs) of abamectin in potential drinking water sources (groundwater and surface water) were modelled. The chronic EEC used in this estimation is 0.91 µg/L (surface water, 90th percentile of yearly average concentrations) modeled using the highest cumulative application rate (6 applications × 22.8 g a.i./ha)
[2] Acceptable daily intake (ADI) of 0.0004 mg/kg bw/day.

Appendix V Occupational handler exposure and risk assessment for abamectin

Table 1 Mixer, loader, applicator occupational exposure and risk assessment - Agriculture

Crop	Formulation	Scenario	Application equipment	Max rate (kg a.i./ha)	ATPD (ha/day)	Dermal exposure[a] (mg/kg bw/day)	Inhalation exposure[b] (mg/kg bw/day)	Dermal MOE[c]	Inhalation MOE[c]	Combined MOE[d]
Apples	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.014	26	3.90E-06	1.07E-05	30 800	11200	8200
			Airblast		20	1.37E-04	3.47E-05	877	3460	699
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.038 g/L[e]	150 L/day	2.32E-05	2.81E-04	5170	427	395
Onion, dry bulb Green onion Subgroup 13-07A	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.023	26	6.22E-06	1.71E-05	19 300	7010	5140
Caneberries	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.019	26	5.18E-06	1.43E-05	23 162	8413	6171
Celery	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.021	26	5.73E-06	1.58E-05	20 956	7611	5583

Crop	Formulation	Scenario	Application equipment	Max rate (kg a.i./ha)	ATPD (ha/day)	Dermal exposure[a] (mg/kg bw/day)	Inhalation exposure[b] (mg/kg bw/day)	Dermal MOE[c]	Inhalation MOE[c]	Combined MOE[d]
Grapes	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.022	26	6.07E-06	1.67E-05	19 800	7180	5270
		Open M/L, Baseline PPE, Open A, Baseline PPE	Airblast		20	2.13E-04	5.40E-05	563	2221	449
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.045 g/L [e]	150 L/day	2.75E-05	3.32E-04	4360	361	333
Pears	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.029	26	7.80E-06	2.15E-05	15 400	5590	4100
		Open M/L, Baseline PPE, Open A, Baseline PPE	Airblast		20	2.74E-04	6.94E-05	438	1730	350

Crop	Formulation	Scenario	Application equipment	Max rate (kg a.i./ha)	ATPD (ha/day)	Dermal exposure[a] (mg/kg bw/day)	Inhalation exposure[b] (mg/kg bw/day)	Dermal MOE[c]	Inhalation MOE[c]	Combined MOE[d]
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.0763 g/L[e]	150 L/day	1.70 E-05	2.11 E-04	6870	568	524
Hops	EC/S	Open M/L, Baseline PPE, Open A, Baseline PPE	GB Farmer LFC	0.021	107	2.40E-05	6.50E-05	5090	1850	1360
		Open M/L, Baseline PPE, Open A, Baseline PPE	GB Custom LFC		306	7.90E-05	2.18E-04	1510	550	403
		Open M/L, Baseline PPE, Open A, Baseline PPE	Airblast		20	2.01E-04	5.01E-05	597	2350	476
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.0525 g/L[e]	150 L/day	3.21E-05	3.88E-04	3740	309	**286**

Crop	Formulation	Scenario	Application equipment	Max rate (kg a.i./ha)	ATPD (ha/day)	Dermal exposure[a] (mg/kg bw/day)	Inhalation exposure[b] (mg/kg bw/day)	Dermal MOE[c]	Inhalation MOE[c]	Combined MOE[d]
Potatoes	EC	Open M/L, Baseline PPE, Open A, Baseline PPE	GB Farmer LFC	0.019	107	2.10E-05	5.90E-05	5630	2040	1500
		Open M/L, Baseline PPE, Open A, Baseline PPE	GB Custom LFC		306	7.20E-05	1.98E-04	1670	608	446
Strawberries	EC	Open M/L, Baseline PPE, Open A, Baseline PPE	GB V&F	0.019	26	5.00E-06	1.40E-05	23 200	8410	6170
		Open M/L, Baseline PPE, Open A, Baseline PPE	Airblast		20	1.82E-04	4.60E-05	660	2600	526
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.051 g/L[e]	150 L/day	3.12E-05	3.77E-04	3850	318	294

Crop	Formulation	Scenario	Application equipment	Max rate (kg a.i./ha)	ATPD (ha/day)	Dermal exposure[a] (mg/kg bw/day)	Inhalation exposure[b] (mg/kg bw/day)	Dermal MOE[c]	Inhalation MOE[c]	Combined MOE[d]
Greenhouse Ornamentals	EC	Open M/L/A, Baseline PPE	MPHG	0.0228 g/L[e]	150 L/day	6.05E-05	1.64E-04	1980	734	536
			MPHW			4.03E-07	1.93E-06	298 000	62 100	51 400
			Backpack		3800 L/day	2.33E-06	2.65E-06	51 500	45 200	24 100
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.0228 g/L	150 L/day	1.39E-05	1.68E-04	8610	712	658
Greenhouse Vegetables (peppers, cucumbers, and tomatoes)	EC	Open M/L/A, Baseline PPE	MPHG	0.0114 g/L[e]	150 L/day	3.02E-05	8.18E-05	3970	1470	1070
			MPHW			2.02E-07	9.66E-07	595 000	124 000	103 000
			Backpack		3800 L/day	1.16E-06	1.33E-06	103 000	90 400	48 200
		Open M/L, Mid-level PPE Open A, Max-level PPE + Respirator	HH AB/MB	0.0114 g/L[e]	150 L/day	6.97E-06	8.42E-05	17 200	1420	1320

Bolded cells indicate calculated MOEs where risks were shown not to be acceptable. ATPD = area treated per day, MOE = margin of exposure, L = Liquid, EC = Emulsifiable Concentrate, S = Suspension, GB = Groundboom, LFC = Large Field Crops, V&G = Vegetables and Fruit, PPE = Personal Protective Equipment, M/L/A = Mix/Load/Apply, MPHG = Manually Pressurized Handgun, MPHW = Manually Pressurized Handwand, HH A/B = Handheld Airblast/Mistblower

Baseline PPE: single layer, CR gloves; Mid-level PPE = coveralls over long-sleeved shirt, long pants, CR gloves; Max-level PPE = CR coveralls with a CR hood over a long sleeved shirt, long pants, socks and shoes, CR gloves, and a respirator

[a] Dermal exposure (mg/kg bw/day) = (dermal unit exposure × ATPD × maximum application rate × 1% dermal absorption)/80 kg body weight

[b] Inhalation exposure (mg/kg bw/day) = (inhalation unit exposure × ATPD × maximum application rate)/80 kg body weight

[c] Based on a Short-, Intermediate-Term NOAEL of 0.12 mg/kg bw/day from a developmental neurotoxicity study, target MOE = 300

[d] Combined MOE = NOAEL/(EXP_{derm}+EXP_{inh}), Short-Term, Target MOE = 300

[e] g/L = maximum label rate (g a.i./ha) / spray volume (L/ha)

Table 2 Mixer, loader, applicator occupational exposure and risk assessment – Indoor/outdoor residential

Pest	Formulation	Scenario	Application equipment	Amount handled per day[a] (kg)	Dermal exposure[b] (mg/kg bw/day)	Inhalation exposure[c] (mg/kg bw/day)	Dermal MOE[d]	Inhalation MOE[d]	Combined MOE[e]
Ants	Granular	Open M/L/A, Baseline PPE	Duster/Puffer	1.10E-04	2.16E-03	8.32E-04	55 400	144 000	40 000
Cockroach	Dry Flowable	Open M/L/A, Baseline PPE	Hand duster	1.80E-04	3.54E-03	1.36E-03	33 900	88 200	24 500

MOE = Margin of Exposure, M/L/A = Mix/Load/Apply, PPE = Personal Protective Equipment
Baseline PPE: single layer, CR gloves
ATPD = area treated per day, MOE = margin of exposure, PPE = Personal Protective Equipment, M/L/A = Mix/Load/Apply
[a] For granular ant products, 1 container of product would be used per day by a PCO (1 kg × 0.011% guarantee = 1.10E-04 kg a.i.). For Dry Flowable cockroach products, 1 container (30 g) would be used by a PCO per apartment dwelling. 12 dwellings would be treated per day (30 g × 0.05% × 12 = 1.80E-04 kg a.i.).
[b] Dermal exposure (mg/kg bw/day) = (dermal unit exposure × ATPD × maximum application rate × 1% dermal absorption)/80 kg body weight. Dermal unit exposure was based on the PHED Granular Bait Dispersed by Hand exposure scenario.
[c] Inhalation exposure (mg/kg bw/day) = (inhalation unit exposure × ATPD × maximum application rate)/80 kg body weight. Inhalation unit exposure was based on the PHED Granular Bait Dispersed by Hand exposure scenario.
[d] Based on a Short-, Intermediate-Term NOAEL of 0.12 mg/kg bw/day from a developmental neurotoxicity study, target MOE = 300
[e] Combined MOE = NOAEL/(EXP_{derm}+EXP_{inh}), Intermediate-term, Target MOE = 300

Appendix VI Occupational postapplication exposure and risk assessment for abamectin

Table 1 Short-term dermal postapplication exposure and risk assessment of abamectin, agricultural (Non-greenhouse)

Crop	Activity	TC (cm^2/hr)[a]	App rate (kg a.i./ha)	# of Applications per year	Interval between applications (Days)	Day 0 DFR ($\mu g/cm^2$)[b]	Dermal exposure (mg/kg/day)[c]	Dermal MOE[d]	REI (days)[e]
Apple	Thinning Fruit	3000	0.0143	1	-	0.04	1.07E-04	1119	0.5
	Harvesting (hand)	1400					5.01E-05	2398	
	Scouting, Pruning, Training	580					2.07E-05	5787	
	Transplanting	230					8.22E-06	14594	
	Weeding, Propping, Orchard Maintenance	100					3.58E-06	33566	
	All other activities	No TC	REI not required						
Onion, Bulb	Weeding, hand	4400	0.0228	3	7	0.10	4.28E-04	**280**	1
	Irrigation, hand	1750					1.70E-04	705	0.5
	Scouting, Thinning, Harvesting	1300					1.26E-04	949	
	All other activities	No TC	REI not required						
Onion, Green	Weeding, hand	4400	0.0228	4	7	0.10	4.56E-04	**263**	2
	Irrigation, hand	1750					1.81E-04	662	0.5
	Scouting, Thinning, Harvesting	1300					1.35E-04	892	
	All other activities	No TC	REI not required						
Caneberries	Irrigation (handset)	1750	0.019	3	7	0.08	1.42E-04	846	0.5
	Hand Harvesting, Tying/Training (full foliage)	1400					1.14E-04	1060	
	Hand Pruning, Scouting, Tying/Training (min. foliage), Hand Weeding	640					5.19E-05	2310	
	Transplanting	230					1.86E-05	6430	
	All other activities	No TC	REI not required						
Celery	Irrigation, hand	1750	0.021	4	7	0.10	1.67E-04	719	0.5
	Transplanting	230					1.05E-04	1144	
	Scouting	210					2.19E-05	5471	
	Harvesting	110					2.00E-05	5992	

Crop	Activity	TC (cm^2/hr)[a]	App rate (kg a.i./ha)	# of Applications per year	Interval between applications (Days)	Day 0 DFR ($\mu g/cm^2$)[b]	Dermal exposure (mg/kg/day)[c]	Dermal MOE[d]	REI (days)[e]
	Weeding, hand	70					6.68E-06	17976	
	All other activities	No TC	REI not required						
Grapes	Girdling, Turning	19 300	0.02226	2	21	0.06	1.21E-03	**99**	11
	Tying, Training, Leaf Pulling (hand)	8500					5.33E-04	**225**	2
	Irrigation, hand	1750					1.10E-04	1094	0.5
	Scouting, Weeding, Propagating, Bird Control, Trellis Repair, Pruning	640					4.01E-05	2991	
	Transplanting	230					1.44E-05	8324	
	All other activities	No TC	REI not required						
Hops	Harvesting, mechanically assisted	19300	0.02226	2	21	0.06	1.12E-03	**107**	10
	Irrigation, hand	1750					1.02E-04	1177	0.5
	Weeding (hand), Stripping, Scouting, Tying/Training	640					3.73E-05	3219	
	Transplanting	230					1.34E-05	8958	
	All other activities	No TC	REI not required						
Pears	Thinning fruit	3000	0.0286	2	21	0.08	2.38E-04	504	0.5
	Harvesting, hand	1400					1.11E-04	1081	
	Pruning, Scouting, Training	580					4.60E-05	2608	
	Transplanting	230					1.82E-05	6577	
	Weeding, Propping, Orchard maintenance	100					7.93E-06	15128	
	All other activities	No TC	REI not required						
Potatoes	Irrigation, hand	1750	0.019	2	7	0.07	1.27E-04	943	0.5
	Rouging	1100					8.00E-05	1500	
	Scouting	210					1.53E-05	7855	
	Weeding	70					5.09E-06	23566	
	All other activities	No TC	REI not required						

Crop	Activity	TC (cm^2/hr)[a]	App rate (kg a.i./ha)	# of Applications per year	Interval between applications (Days)	Day 0 DFR ($\mu g/cm^2$)[b]	Dermal exposure (mg/kg/day)[c]	Dermal MOE[d]	REI (days)[e]
Strawberries	Hand Harvesting	1100	0.019	2	7	0.07	7.72E-05	1550	0.5
	Transplanting	230					1.62E-05	7430	
	Scouting	210					!.47E-05	8140	
	Canopy Management, Hand Weeding	30					4.90E-06	24400	
	All other activities	No TC	REI not required						

Bolded cells indicate calculated MOEs where risks were shown not to be acceptable. TC = Transfer coefficient, DFR = Dislodgeable Foliar Residue, MOE = Margin of Exposure, REI = restricted-entry interval

Since no DFR studies were submitted, a peak default DFR value of 25% of the application rate and a dissipation rate value of 10% were used.

[a] The TC values are from the PMRA Transfer Coefficient Spreadsheet, 6 March 2019 (PMRA, 2012c). The TC value for maximum foliage density was considered as a worst case scenario for the risk assessment

[b] DFR (day *n*) = DFR $_{n-1}$- (DFR$_{n-1}$ × Dissipation rate (default 10%)) or DFR (multiple application) = DFR $_{n-1}$ - (DFR$_{n-1}$ × Dissipation rate (default 10%)) + DFR$_0$

[c] Dermal exposure (mg/kg bw/day) = DFR (ug/cm²) × TC (cm²/hr) × work duration (8 hr) × DA / BW (80kg)

[d] Based on the short-term, dermal NOAEL of 0.12 mg/kg bw/day and a target MOE of 300

[e] If the target MOE is met, the REI is set at 12 hours as per label.

Table 2 Intermediate-, long-term dermal postapplication exposure and risk assessment of abamectin, agricultural (Greenhouse)

Crop	Activity	TC (cm^2/hr)[a]	App rate (kg/ha)	# of Applications per Year	Interval Between Applications (Days)	Day 0 DFR ($\mu g/cm^2$)[b]	Dermal Exposure (mg/kg/day)[c]	Dermal MOE[d]	REI (days)[e]
Greenhouse pepper, cucumbers	All Activities	1400	0.0228	5	7	0.22	3.07E-04	391	0.5
Greenhouse tomatoes	All Activities	1400	0.0228	2	7	0.11	1.49E-04	805	0.5
Greenhouse Ornamentals (Cut flower production)	Disbudding, Hand Harvesting, Hand Pruning	4000	0.0228	5	7	0.25	9.98E-04	**121**	45
	Irrigation (handset)	1750					4.33E-04	**277**	4
	Container Moving, Pinching, Plant support/staking, Scouting, Transplanting, Hand Weeding	230					5.69E-03	2110	0.5
Greenhouse Ornamentals (not for cut flower production)	All Activities	230	0.0228	5	7	0.25	5.69E-03	2110	0.5

Bolded cells indicate calculated MOEs where risks were shown not to be acceptable. TC = Transfer coefficient, DFR = Dislodgeable Foliar Residue, MOE = Margin of Exposure, REI = restricted-entry interval

Since no DFR studies were submitted, a peak default DFR value of 25% of the application rate and a dissipation rate value (greenhouse) of 2.0% were used.

[a] The TC values are from the PMRA Transfer Coefficient Spreadsheet, 6 March 2019 (PMRA, 2012c). The TC value for maximum foliage density was considered as a worst case scenario for the risk assessment

[b] DFR (day *n*) = DFR (multiple application) = DFR_{n-1} - (DFR_{n-1} × Dissipation rate (default 2.0%)) + DFR_0

[c] Dermal exposure (mg/kg bw/day) = DFR (ug/cm²) × TC (cm²/hr) × work duration (8 hr) × DA / BW (80kg)

[d] Based on the short-term, dermal NOAEL of 0.12 mg/kg bw/day and a target MOE of 300

[e] If the target MOE is met, the REI is set at 12 hours.

Appendix VII Non-Occupational (Residential) exposure and risk assessment for Abamectin

Table 1 Non-Occupational (Residential) postapplication exposure and risk assessment for Abamectin

Scenario	Lifestage	DFR_0 (ug/cm^2)[a]	Weight unit conversion factor (mg/ug)	Transfer Coefficient (cm^2/hr)[b]	Exposure Time (hr)	Body Weight (kg)	Dermal Exposure (mg/kg/bw/day)[c]	Dermal MOE[d]
Trees	Adult	0.08	0.001	1700	1	80	1.70E-05	7059
	Children 6 < 11			930	0.5	32	1.16E-05	10323

DFR = dislodgeable foliar residue, MOE = Margin of Exposure

[a]Maximum DFR after 2 applications with 21 days between applications (pears).

[b]TC = transfer coefficient. TCs from the USEPA Residential SOP, Section 4: Gardens and Trees (USEPA, 2012)

[c]Exposure = DFR (ug/cm^2) × 0.001 × DA (1%) × TC × exposure time/Body Weight.

[d]Short-term NOAEL of 0.12 mg/kg bw/day from a rat neurotoxicity study, target MOE of 300.

Appendix VIII Aggregate exposure and risk assessment for abamectin

Table 1 Aggregate exposure and risk assessment

Sub-population	Scenario	Residential postapplication exposure[a] (mg/kg bw/day)	Dietary exposure (mg/kg bw/day)	Total exposure[b] (mg/kg bw/day)	Aggregate MOE[c] Target = 300
Adults	Trees	1.70E-05	3.60E-05	5.30E-05	2264
Children 6 < 11 yrs		1.16E-05	4.90E-05	6.06E-05	1979

MOE = margin of exposure

[a] Total exposure from post-application activities. See Section 3.4.2.2 and Appendix V for more information.

[b] Total exposure from residential, dermal, and chronic dietary exposure.

[c] MOE = NOAEL/Total Exposure. Based on the aggregate endpoints. Short-term NOAEL of 0.12 mg/kg bw/day from a rat neurotoxicity study, target MOE of 300.

Appendix IX Environmental assessment

Table 1 Major fate inputs for the modelling

Parameter	Drinking water	Ecological water
Molecular weight (g/mol)	873.1	873.1
Vapour pressure (mm Hg)	1.50E-09	1.50E-09
Henry's law constant (unitless)	3.47E-06	3.47E-06
Solubility in water at pH 7 and 25°C (mg/L)	0.02031[1]	0.02031
K_d (L/Kg)	20.9[1]	NA
K_{oc} (L/Kg)	NA	5938
Photolysis half-life (day)	1.69[2]	1.50
Hydrolysis half-life at pH 7 and 25°C (day)	stable	stable
Aerobic soil half-life at 20°C (day)	152	40
Aerobic aquatic half-life at 20°C (day)	139	91.3
Anaerobic aquatic half-life at 20°C (day)	585	312
Diffusion coefficient in air (cm2/day)	2100	2100
Heat of Henry (J/mole)	49284	49284

[1]Kd used due to no correlation between Kd and organic carbon for NOA448112
[2]K_{oc} used due to very good correlation between Kd and organic carbon for abamectin

Table 2a Level 1 Estimated environmental concentrations (in µg a.i./L) of parent abamectin and transformation products in potential sources of drinking water

Crop/use pattern	Groundwater (µg a.i./L)		Surface Water (µg a.i./L)	
	Daily[1]	Yearly[2]	Daily[3]	Yearly[4]
Ornamentals/ 6 × 22.8 g a.i./ha @ 7-d	0.0082	0.0080	2.5	0.91
Crops/ 5 × 19 g a.i./ha @ 7-d	0.0057	0.0056	1.8	0.63

[1] 90th percentile of daily average concentrations
[2] 90th percentile of 365-day moving average concentrations
[3] 90th percentile of the peak concentrations from each year
[4] 90th percentile of yearly average concentrations

Table 2b Level 1 Estimated environmental concentrations in µg a.i./L of parent abamectin in water habitats for the ecological risk assessment of abamectin

Crop/use pattern	Water depth (cm)	Water column				Pore water	
		Peak	24 hour	96 hour	21 day	Peak	21 day
Pear/ 1 × 28.6 g a.i./ha @ 7 d	15	0.2	0.095	0.030	0.012	NA	NA
	80	0.040	0.034	0.023	0.011	0.0077	0.0077
Raspberry/ 5 × 19 g a.i./ha @ 7 d	15	5.2	2.4	0.94	0.49	NA	NA
	80	1.2	1.0	0.73	0.43	0.31	0.30
Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d	15	7.0	3.3	1.3	0.69	NA	NA
	80	1.7	1.5	1.1	0.62	0.44	0.43

Table 3 Fate and behaviour in the environment

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
Abiotic transformation					
Hydrolysis	Avermectin B1a	20ºC, pH 5-8: Stable 25ºC, pH 9: Half-life = 206 d	Major: No major transformation product formed.	Abamectin is stable to hydrolysis in environmentally relevant conditions.	1239226 2386135 2386487
Phototransformation in soil Gartenacker Les Barges soil (2% OC)	Avermectin B1a	Under irradiation: Half-life =12.6 d Environmental half-life = 24 d Dark Control Half-life = 120 d	Major, Irradiated: No major transformation products Minor, irradiated: NOA 448111: 5.7%AR NOA 448112: 4%AR	Soil photolysis is not a significant route of dissipation for Abamectin	2386174
Phototransfor-mation in water	Avermectin B1a	Irradiated: Avermectin B1a: half-life = 2 d Environmental half-life = 1.5 d (for eco-modelling) ABM + NOA 448111 Half-life = 2.23 d Environmental half-life = 1.69 d (for modelling drinking water).	Major, Irradiated: No major transformation products Minor, irradiated: NOA 448111: 5.6%AR NOA 427011: 8.2%AR	Aqueous photolysis is a significant route for dissipation of abamectin in the environment	2386172
Phototransformation in air	Abamectin	Data were not required.			
Biotransformation					
Biotransformation in aerobic soil	^{14}C-avermectin B1a at 30ºC and 40% WHC	Gartenacker soil (loam/ silt loam, %OC 2.35, pH 7.23) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 50.5 d (DFOP) DT_{90}: 217 d rep half-life =72.2 d	Major: NOA 448111: 13.8%AR NOA 448112: 13.0 %AR NER: 34.9% AR CO_2: 17% AR Minor NOA 457464: 6.3%AR NOA 457465: 6.2%AR		2395803
	^{14}C-avermectin B1a at 20ºC and 40%	Gartenacker soil (loam/ silt loam, %OC 2.35, pH 7.23) Combined residue of	Major: NOA 448111: 10.6%AR NOA 448112: 13%AR NOA 457464: 9.9 %AR		

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
	WHC	ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 71.1 d (IORE) DT_{90}: 651 d rep half-life =196 d	NER: 26.9% AR Minor NOA 457465: 8.2%AR CO_2: 8.1 % AR		
	^{14}C-avermectin B1a at 10ºC and 40% WHC	Gartenacker soil (loam/ silt loam, %OC 2.35, pH 7.23) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 167 (SFO) DT_{90}: 554 d rep half-life =167 d	Major: NOA 448111: 10.8%AR NOA 448112: 15%AR NER: 13.8 % AR Minor NOA 457464: 7.1 %AR NOA 457465: 4.4%AR CO_2: 1.4 % AR		
	^{14}C-avermectin B1a at 30ºC and 25% WHC	Gartenacker soil (loam/ silt loam, %OC 2.35, pH 7.23) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 77.8 (DFOP) DT_{90}: 455 d rep half-life =165 d	Major: NOA 448112: 12.9%AR NER: 26.6 % AR Minor NOA 448111: 9.3%AR NOA 457464: 9%AR NOA 457465: 9.2%AR CO_2: 8.2 % AR		
	^{14}C-avermectin B1a at 20ºC	Gartenacker soil (loam, %OC 1.86, pH 7.28) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 65.1 (DFOP) DT_{90}: 413 d rep half-life =157 d	Major: NOA 448111: 10.3%AR NOA 448112: 15.7%AR NER: 33. 9 AR CO_2: 27.6 % AR Minor NOA 457464: 9.3 %AR NOA 457465: 8.5%AR		937801

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
	^{14}C-avermectin B1a at 20ºC	Pappelacker soil (Loamy sand, %OC 1.4, pH 7.4) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 55.9 (IORE) DT_{90}: 379 d rep half-life =114 d	Major: NOA 448112: 13.4%AR NOA 457465: 9.9%AR NER: 33. 0 %AR CO_2: 18.7 % AR Minor NOA 448111: 9.1%AR NOA 457464: 7.6 %AR		2394773
		18 Acres soil (Sandy clay loam, %OC 2.5, pH 5.8) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 12.7 (IORE) DT_{90}: 77.1 d rep half-life =23.2 d	Major: NER: 44.1 %AR CO_2: 12.9% AR Minor NOA 448111: 3.8%AR NOA 448112: 0.9%AR NOA 457464: 0.5 %AR NOA 457465: 3.9%AR		
		Marsillargues soil (Silty clay loam, %OC 1.4, pH 7.9) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 87 (SFO) DT_{90}: 289d rep half-life =87 d	Major: NER: 30 %AR CO_2: 13.4 % AR Minor NOA 448111: 6%AR NOA 448112: 8.8%AR NOA 457464: 5.5 %AR NOA 457465: 5.2 %AR		
Biotransformation of avermectin B1a only in environment					
Aerobic biotransformation in soil	Avermectin B1a	Gartenacker soil at 30°C and 40WHC	DT_{50}: 14.9 d (IORE) DT_{90}: 75.3 d rep half-life =22.7 d	Avermectin B1a is slightly persistent in this condition	2395803
		Gartenacker soil at 20°C and 40WHC	DT_{50}: 21.7 d (IORE) DT_{90}: 88.3 d rep half-life =26.6 d		
		Gartenacker soil at 10°C and 40WHC	DT_{50}: 59.4 d (SFO) DT_{90}: 197.5 d rep half-life =59.4 d	Avermectin B1a is moderately persistent in this condition	

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
		Gartenacker soil at 30°C and 25WHC	DT_{50}: 22.7 d (IORE) DT_{90}: 93.4 d rep half-life =28.1 d		
		Gartenacker soil at 20°C	DT_{50}: 15.4 d (IORE) DT_{90}: 88.5 d rep half-life =26.6 d	Avermectin B1a is slightly persistent in this condition	937801
		Pappelacker at 20°C	DT_{50}: 23.1 d (SFO) DT_{90}: 76.7 d rep half-life =23.1 d		
		18 Acres at 20°C	DT_{50}: 10.2 d (IORE) DT_{90}: 54.5 d rep half-life =16.4 d	Avermectin B1a is slightly persistent in this condition	2394773
		Marsillargues at 20°C	DT_{50}: 49.2 d (SFO) DT_{90}: 163.3 d rep half-life =49.2 d	Avermectin B1a is moderately persistent in this condition	
		LUFA, Speyer 2.2 at 20°°C	DT_{50}: 15.6 d (IORE) DT_{90}: 99.9 d rep half-life =30.1 d		
		LUFA, Speyer 2.1 at 20°C	DT_{50}: 18.8 d (SFO) DT_{90}: 62.3 d rep half-life =18.8 d		
		LUFA, Speyer 2.3 at 20oC	DT_{50}: 27.9 d (SFO) DT_{90}: 92.8 d rep half-life =27.9 d	Avermectin B1a is slightly persistent in this condition	3019908
		LUFA, Speyer 5M at 20°C	DT_{50}: 26.5 d (SFO) DT_{90}: 88 d rep half-life =26.5 d		
		LUFA, Speyer 2.2 at 10°C	DT_{50}: 26.4 d (IORE) DT_{90}: 166.4 d rep half-life =50.1 d		
Anaerobic biotransformation in soil					
Biotransformation in anaerobic soil	^{14}C-avermectin B1a at 20ºC	Gartenacker soil (loam, %OC 1.86,pH 7.28) Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 457464 + NOA 457465 DT_{50}: 216 (DFOP) DT_{90}: 2162 d rep half-life =838 d	Major: NOA 448111: 10.1%AR NOA 448112: 15.2%AR NER: 28.4%AR Minor NOA 457464: 5 %AR NOA 457465: 3.1%AR CO_2: 3%AR		937801
Anaerobic biotransformation of abamectin alone in soil					
Anaerobic biotransformation in soil		Anaerobic Gartenacker soil at 20°C	DT_{50}: 80 d (SFO) DT_{90}: 3922 d rep half-life =1659 d	Abamectin is persistent in this condition	937801

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
Aquatic biotransformation					
Aerobic condition					
Biotransformation in aerobic water system	^{14}C-avermectin B1a at 20°C	Rhine River System: (water:sandy loam sediment system) pH 7.21, redox: -512mV, O_2 (mg/L) 7.74, %OC 1.48 Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 426289 + NOA 445495 Total System: DT_{50}: 122 (SFO) DT_{90}: 406 d rep half-life =122 d Water phase: DT_{50}: 0.72 (IORE) DT_{90}: 16.2 d rep half-life =4.89 d	Major: NER: 20.4%AR Minor NOA 448111: 2.2%AR NOA 448112: 2%AR NOA 426289: 7%AR NOA 445495: 2.0%AR CO_2: 3%AR		2663867
		Pond (Rothenfluh) System: (water:silty clay loam sediment system) pH 7.09, redox: -501mV, O_2 (mg/L) 4.52, %OC 4.52 Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 426289 + NOA 445495 Total System: DT_{50}: 139 (SFO) DT_{90}: 463 d rep half-life =139 d Water phase: DT_{50}: 1.28 (IORE) DT_{90}: 27.3 d rep half-life =6.47 d	Major: NER: 23.2%AR Minor NOA 448111: 2.9%AR NOA 448112: 1.8%AR NOA 426289: 8.9%AR NOA 445495: 1.7 %AR CO_2: 3.2 %AR		2663867

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
Anaerobic condition					
Biotransformation in anaerobic water system	^{14}C-avermectin B1a at	Rhine River System: (water:sandy loam sediment system) pH 7.21, redox: -512mV, O_2 (mg/L) 7.74, %OC 1.48 Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 426289 + NOA 445495 Total System: DT_{50}: 497 (SFO) DT_{90}: 1652 d rep half-life =497 d Water phase: DT_{50}: 2.74 (DFOP) DT_{90}: 84.5 d rep half-life =39.2 d	Major: NOA 445495: 11.6%AR Minor NOA 448111: <1%AR NOA 448112: <1%AR NOA 426289: <1%AR CO_2: 0.1%AR NER: 4.9%AR		2663867
		Pond (Rothenfluh) System: (water:silty clay loam sediment system) pH 7.09, redox: -501mV, O_2 (mg/L) 4.52, %OC 4.52 Combined residue of ABM B1a + NOA 448111 + NOA 448112 + NOA 426289 + NOA 445495 Total System: DT_{50}: 585 (SFO) DT_{90}: 1942 d rep half-life =139 d Water phase: DT_{50}: 3.26 (IORE) DT_{90}: 62.3 d rep half-life =18.8 d	Major: NOA 445495: 7.6 %AR Minor NOA 448111: <1%AR NOA 448112: <1%AR NOA 426289: <1%AR CO_2: 0.1 %AR NER: 4.3%AR		2663867

Property	Test substance	Value[1]	Transformation[1] products	Comments	Reference PMRA#
Aquatic biotransformation of avermectin B1a alone					
Aerobic condition	Avermectin B1a	Total Rhine River system	DT_{50}: 86.9 d (SFO) DT_{90}: 288.7 d rep half-life =86.9 d	Avermectin B1a is moderately persistent in this condition	2663867
		Total Pond system	DT_{50}: 91.3 d (SFO) DT_{90}: 303.2 d rep half-life =91.3 d		
		Water phase Rhine River system	DT_{50}: 0.8 d (IORE) DT_{90}: 14.28 d rep half-life =4.3 d	Avermectin B1a is non-persistent in this phase	2663867
		Water phase Pond system	DT_{50}: 1.3 d (IORE) DT_{90}: 18.9 d rep half-life =5.7 d		
Anaerobic condition	Avermectin B1a	Total Rhine River system	DT_{50}: 229.6 d (SFO) DT_{90}: 762.7 d rep half-life =229.6 d	AvermectinB1a is persistent in this condition	2663867
		Total Pond system	DT_{50}: 311.6 d (SFO) DT_{90}: 1035 d rep half-life =311.6 d		
		Water phase Rhine River system	DT_{50}: 2.9 d (DFOP) DT_{90}: 75.2 d rep half-life =35.5 d	Avermectin is non-persistent in this phase	
		Water phase Pond system	DT_{50}: 3.2 d (IORE) DT_{90}: 57.7 d rep half-life =17.4 d		

Mobility

Property	Test substance	Soil type	Kd (L/kg)	K_{oc}(L/kg)	Comments	PMRA#
Adsorption / desorption in soil	Avermectin B1a (NOA422601)	Borstel Loamy Fine Sand	90.3	5905	Abamectin is classified as immobile in the soils tested.	3006342 3006344
		Pappelacker Loamy Fine Sand	74.3	7586		
		Schwadreloch Sandy Loam	83.1	6489		
		Gartenacker Loam	157.8	6091		
		Vetroz Silt Loam	297.3	5946		
	8a-oxo avermectin B1a NOA 448111	Pappelacker loamy sand	38.3	3912	8a-oxo avermectin B1a is classified as slightly mobile in the soils tested.	3006342 3006344
		Gartenacker loam/silt loam	78.4	3027		
		18 Acres sandy clay loam	128	5052		
	8a-hydroxy avermectin B1a NOA 448112	Pappelacker loamy sand	15.9	1626	8a-hydroxy avermectin B1a is classified as having low mobility in the soils tested	
		Gartenacker loam/silt loam	28.4	1098		
		18 Acres sandy clay loam	78.9	3104		
	4, 8a-dihydroxy avermectin B1a NOA 457464	Pappelacker loamy sand	16.9	1690	4, 8a-dihydroxy avermectin B1a is classified as having low mobility in the soils tested	
		Gartenacker loam/silt loam	28	1082		
		18 Acres sandy clay loam	61.3	2423		

Property	Test substance	Value[1]	Transformation[1] products		Comments	Reference PMRA#
	4-hydroxy 8a-oxo-avermectin B1a NOA 457465	Pappelacker loamy sand	32.7	3338	4-hydroxy-8a-oxo-avermectin B1a is classified as slightly mobile in the soils tested	
		Gartenacker loam/silt loam	66.6	2573		
		18 Acres sandy clay loam	148	5813		

Field dissipation studies[2]

Field and Study description	Test substance	DT_{50} Value	Transformation products	Comments	Reference PMRA#
Field dissipation in Dugliolo, Po Valley, Italy, Bare plot, Loamy soil, pH 7.6. **Field grown with wheat previously. Abamectin never used on site. Prior use of following pesticides: MCCP, ioxynil, glyphosate and bromoxynil.**	Abamectin (1.8% EC) applied at 27 g a.i/ha	DT_{50} = 0.1 (2.4 hrs) DT_{90} = 2.13 Rep.half-life = 2.92 (DFOP)	No transfor-mation product detected	Avermectin B1a is non-persistent under the terrestrial field conditions tested.	1095546 3866635
Field dissipation in Juzancourt, Champagne, France, Bare plot,Loamy soil, pH 6.3. **Field grown with lucern previously. Abamectin never used on site. Prior use of following pesticides: deltamethrin, hexazinone, paraquat, glyphosate and PKMg-fertilisation in previous year.**	Abamectin (1.8% EC) applied at 27 g a.i/ha	DT_{50} = 0.26 (6.2 hrs) DT_{90} = 0.9 Rep.half-life = 0.26 (SFO)	No transformation product detected.	Avermectin B1a is non-persistent under the terrestrial field conditions tested.	1095547 3866636
Field dissipation in Neu Ulm-Ludwigsfeld, Bavaria, Germany, Bare plot, Silty loam clay soil, pH 7.6. **Field grown with maize in previous year. Abamectin never used on site.**	Abamectin (1.8% EC) applied at 27 g a.i/ha	DT_{50} = 0.32 (7.7 hrs) DT_{90} = 3.17 Rep.half-life = 1.51 (DFOP)	No transformation product detected	Avermectin B1a is non-persistent under the terrestrial field conditions tested.	1095548 3866637

Property	Test substance	Value[1]	Transformation[1] products		Comments	Reference PMRA#
Field dissipation in Wissembourg, Schleithal, Alsace, France, Bare plot, Silty soil, pH 5.7. **Field grown with maize in previous year. Abamectin never used on site. Prior use of following pesticides: alachlor, carbofuran, dicamba, atrazine and bromoxynil.**		Abamectin (1.8% EC) applied at 27 g a.i/ha	DT_{50} = 0.51 (12 hrs) DT_{90} = 1.70 Rep.half-life = 0.51 (SFO)	No transformation product detected	Avermectin B1a is non-persistent under the terrestrial field conditions tested.	1095549 3866638
Field dissipation in Wallersdorf-See, Germany, Bare plot, clayey loam soil, pH 6.15. **Field grown with sugar beets in previous year. Abamectin never used on site. Prior use of following pesticides: metamitron, chloridazon, epoxiconazole and calcium ammonium nitrate.**		Abamectin (1.8% EC) applied at 22.5 g a.i/ha	Too few data points for accurate model fit	No transformation product detected		2757909 3019908
Field dissipation in Wayne County, New York. **Bare plot- loamy sand, pH 6.2. Plot treated with 2,4-D and Triclopyr in 3 previous years.**		Application 1 on soil @83 g a.i/ha	DT_{50} = 3.18 DT_{90} = 21 Rep.half-life = 8.1 (DFOP)	8,9-Z-(isomer) avermectin B1a was detected.	Avermectin B1a is non-persistent under the terrestrial field conditions tested	2757907
		Application 2 on soil @83 g a.i/ha	DT_{50} = 5.6 DT_{90} = 3414 Rep.half-life = 1030(IORE)			
		Application 3 on soil @83 g a.i/ha	DT_{50} = 24.8 DT_{90} = 82.4 Rep.half-life = 24.8 (SFO)		Avermectin B1a is slightly persistent under the terrestrial field conditions tested	
		Application 4 on soil @83 g a.i/ha	DT_{50} = 11.5 DT_{90} = 38.2 Rep.half-life = 11.5 (SFO)		Avermectin B1a is non-persistent under the terrestrial field conditions tested	
Turf plot- Loamy sand, pH 7. Plot grown with Turf in last three years and treated with Glyphosate and Paraquat.		Application 1 on grass @83 g a.i/ha	DT_{50} = 1.49 DT_{90} = 4.94 Rep.half-life = 1.49 (SFO)		No classification	
		Application 2 on grass @83 g a.i/ha	DT_{50} = 6.48 DT_{90} = 21.5 Rep.half-life = 6.48			

Property	Test substance	Value[1]	Transformation[1] products		Comments	Reference PMRA#
			(SFO)			
		Application 3 on grass @83 g a.i/ha	DT_{50} = 3.7 DT_{90} = 12.3 Rep.half-life = 3.7 (SFO)			
		Application 4 on grass @83 g a.i/ha	DT_{50} = 6.33 DT_{90} = 21 Rep.half-life = 6.33(SFO)			
		Application 1 on grass +soil @83 g a.i/ha	DT_{50} = 9.18 DT_{90} = 95.2 Rep.half-life = 28.7 (IORE)			
		Application 2 on grass +soil @83 g a.i/ha	DT_{50} = 7.58 DT_{90} = 64.5 Rep.half-life = 24.6(DFOP)		Abamectin residues were non-persistent	
		Application 3 on grass +soil @83 g a.i/ha	DT_{50} = 6.61 DT_{90} = 532 Rep.half-life = 160 (IORE)			
		Application 4 on grass +soil @83 g a.i/ha	DT_{50} = 18.4 DT_{90} = 269 Rep.half-life = 80.9 (IORE)			

[1] Kinetics models: SFO = single first-order; IORE = indeterminate order rate equation; DFOP = double first order in parallel; T_R = representative half-life (IORE); Slow t½= representative half-life (DFOP); [2] TFD studies did not measure a large number of transformation products. Legends: NER, non-extracted residues.

Table 4 Toxicity to non-target terrestrial species

Organism	Exposure	Test substance	Endpoint value	PMRA#
Invertebrates				
Earthworm *Eisenia fetida*	28-d	abamectin (97% purity)	14 d LC_{50}: 33 mg a.i./kg dw soil (nomimal concentration)	1238948
	14-d	8,9-Z-avermectin B1a (NOA 427011) (98.8% purity)	14 d LC_{50}: 50 mg /kg dw soil	3082878
	14-d	8a-hydroxy-avermectin B1a (NOA 448112) (91.7% purity)	14 d LC_{50}: 321mg /kg dw soil	
	14-d	Vertimec 0.18 EC	14 d LC_{50} >20 mg	

Organism	Exposure	Test substance	Endpoint value	PMRA#
	Mortality assessed after 7 and 14 d	(19.46 g a.i./L) on artificial soil .	a.i./kg dw soil	
	56-d Chronic		NOEC: 0.72 mg a.i./kg dw soil	
	56-d repro (4 weeks adult mortality, 4 weeks juvenile development)	Abamectin 1.8% EC (1.695% /v)	NOEC:<0.072 mg a.i./kg dw soil	3019905
Earthworm (*Eisenia andrei*)		8a-hydroxy-avermectin B1a (NOA 448112) (97.6% purity)	NOEC: 3.66 mg/kg dw soil	3019907
Springtail Collembolan (*Folsomia candida)*	14-d	8a-hydroxy-avermectin B1a (NOA 448112) (96.02% purity)	14 d LC_{50}: >0.15 mg/kg dw soil	3019907
	28-d	Abamectin 1.8% EC (1.86% /v) (18.6 g/L)	LC_{50}: 1.944 mg a.i./kg dw soil	3019905
			NOEC =0.103 mg a.i./kg dw soil	
Honeybee (*Apis mellifera*)	24-hr Acute contact	Abamectin (purity 97%)	24 hr LD_{50}= 0.001µg a.i./bee	1238947 3019909 3019907
	24-hr Acute oral		24 hr LD_{50}: 0.004 µg a.i./bee (oral)	
	72 hr-Acute Oral	Abamectin technical (98.7% purity)	72 hr LD_{50}: = 0.0069 µg a.i./bee	3019907
	Acute, Foliar residue	Agrimek 0.15 EC (2.06% purity)	RT_{25}[b]= between 3 and 8 hours (Appl. rate of 26.23 g a.i./ha)	2842020
	8-d acute larva	Abamectin (98.5% purity)	8 d LD_{50}: 0.0038 µg a.i./larva/day 8 d NOED: 0.0025 µg a.i./larva/day	2556776
		Abamectin 1.8% EC (1.86% w/v)	8 d LD_{50}: 0.000152 µg a.i ./larva 8 d NOED: 0.0000157 µg a.i ./larva	3019905
		Abamectin SC (A1379610) (1.73% purity)	8 d LD_{50}: 0.00012 µg a.i ./larva/day 8 d NOED: 0.000064 µg a.i . /larva	2702462
	10- d Chronic oral	Abamectin technical (95% purity)	10 d NOED: 0.000166 µg a.i./bee/day	2556772
		Abamectin 1.8% EC	10 d NOED: 0.000102 µg a.i./bee/day	3019905

Organism	Exposure	Test substance	Endpoint value	PMRA#
	22 d chronic test.	Abamectin technical (98.8% purity)	22 d NOED: 0.000010 µg a.i . /larva/day (for pupal survival and adult emergence)	2842018
	Semi-field (tunnel) study (65- days)	Abamactin SC A15368D	Residues 4 hrs after application: 3.5 mg/kg on flower 2.9 mg/kg on leaves. Residues 3 and 7 days after application: 0.58 and 0.53 mg/kg, respectively. Residues on pollen at DAT 1: 0.016 mg/kg	2842021
Predatory mite, *Typhlodromus pyri*	14 d (extended laboratory test) on leaf discs of *Phaseolus vulgaris*	A-8612 A abamectin EC (17.9 g/L)	14 d ER_{50} : 0.182 g a.i./ha (95% CI 0.145 – 0.239 g a.i./ha)	3082878
Parasitoid, *Aphidius rhopalosiphi*	48-hr extended laboratory test on potted barley plants	Vertimec 018 EC A-8612 A abamectin EC (17.9 g/L)	48 h LR_{50}: 0.143 g a.i./ha	
Soil predatory mite (*Hypoaspis aculeifer*)	14-d exposure	Abamectin 1.8% EC (1.86% /v) (18.6 g/L)	LR_{50}: >19.436 mg a.i./kg dw soil NOEC = 3.333 mg a.i./kg dw soil (reproduction)	3019905
	14-d exposure (assessment of adult mortality and reproduction on 16 d)	8a-hydroxy-avermectin B1a (NOA 448112) (97.6% purity)	NOEC: 0.146 mg/kg dw soil	3019907
Adult Carabid beetle *Poecilus cupreus* (2-3 wks old).	14-d exposure under laboratory conditions on beetles, food and sand	Vertimec 018 EC A-8612 A abamectin 0.18 EC (19.46 g/L)	14 d LR_{50}: >58 g a.i/ha (mortality and food consumption)	3082878
Predatory bug, *Orius laevigatus*	9 d extended laboratory test	Abamectin 1.8% EC (nominal a.i. content: 1.8% (w/v) (a.i. analysed: 1.639% (w/v))	9d LR_{50} = 1.67 a.s./ha (nominal rate)	3019905
Birds				
Northern Bobwhite quail, *Colinus virginianus*	14-d Acute oral	Abamectin (91% purity)	LD_{50}: >2000 mg a.i./kg bw	1238968
	22-w Reproduction	Abamectin (90.2% purity)	22-d NOEC: 1.0 mg a.i./kg diet/d	3019907
Mallard duck, *Anas platyrhynchos*	14-d Acute oral	Abamectin (91% purity)	LD_{50}: 26 mg a.i./kg bw (corrected for regurgitation)	

Organism	Exposure	Test substance	Endpoint value	PMRA#
	22-w Reproduction	Abamectin (94.7 % purity)	22-w NOEC: 6 mg a.i./kg diet NOEC: 0.7 mg a.i./kg diet/d	1238972 1238929
Mammals				
Rat, Sprague Dawley	Acute, oral	Abamectin	Male: LD_{50} = 8.7 mg a.i./kg bw	3019907
	2-generation reproductive toxicity study (gavage)	Abamectin	Offspring NOAEL = 0.12 mg/kg bw/day LOAEL =40 mg/kg bw/day	2529526
Vascular plants				
Vascular plant, 6 species: 3 monoccots: *Avena sativa* (oats), *Allium cepa* (onion), *Zea mays* (maize) and; 3 dicots: *Beta vulgaris* (sugar beet), *Brassica napus* (rape), *Glycine max* (soybean)	14-d Vegetative vigour / *Glycine max* (soybean)	Abamectin 1.8% EC (analysed purity 1.695% w/v)	ER_{25} >49.5 g a.i./ha (measured concentration) (biomass inhibition of 24.74%)	3019907

[a] Atkins et alii.(1981) for bees and USEPA classification for others, where applicable; n/a =not applicable
[b] RT_{25}: residual time needed to reduce the activity of the test substance and bring the test organism mortality down to 25%

Table 5 Toxicity of abamectin and transformation products to non-target aquatic species

Organism	Exposure	Test substance	Endpoint value	PMRA #
Freshwater invertebrates				
Cladocera *Daphnia magna*	48hr-Acute Static	Abamectin technical (88.5%)	LC_{50}: 0.56 µg a.i./L (initial measured concentration)	3019907
		Avermectin B1a (11.3%)	LC_{50}: 0.26 µg a.i./L (mean measured concentration in overlying test water)	
			LC_{50}: 0.37 µg a.i./L (mean measured concentration)	
		Abamectin 1.8% EC	EC_{50}: 0.603 µg a.i./L (mean measured concentrations)	
Daphnia galeata		Abamectin technical (89.3% purity)	EC_{50}: 0.55 µg a.i./L (nominal concentrations)	
Daphnia longispina			EC_{50}: 0.38 µg a.i./L (mean measured concentrations)	
Daphnia pulex			EC_{50}: 0.12 µg a.i./L (mean measured concentrations)	
Daphnia simocephalus			EC_{50}: 0.30 µg a.i./L (mean measured concentrations)	
Daphnia Diaphanosoma			EC_{50}: 0.53 µg a.i./L (nominal concentration)	

Organism	Exposure	Test substance	Endpoint value	PMRA #
Cladocera *Daphnia magna*	48hr-Acute	8,9-Z-avermectin B1a (NOA 427011), 98.8% purity	EC_{50}: 0.082 µg L (mean measured concentrations)	
		8a-oxo-avermectin B1a (NOA 448111) (97.7% purity)	EC_{50}: 3.53 µg /L (mean measured)	
		8a-hydroxy-avermectin B1a (NOA 448112) (91.7% purity)	EC_{50}: 1.6 µg./L (mean-measured concentrations)	937802 3019907
	48-hr (static)	4-oxo-avermectin B1a (NOA 426289) (98% purity)	EC_{50}: 0.28 µg./L (nominal concentrations)	3019907
	48hr-Semi Static	4,8a-dihydroxy-avermectin B1a (NOA 457464) (99.7% purity)	EC_{50}: 854 µg/L (measured concentrations within 89% of nominal).	
		4-hydroxy-8a-oxo-avermectin B1a (NOA 457465) (94.4% purity)	EC_{50}: 302.7 µg./L (mean measured concentrations)	
Cladocera *Daphnia magna*	21 d-Chronic semi-static	Abamectin 1.8% EC (1.8% a.i. w/v nominal; 1.695% w/v analysed)	NOEC =0.0082 ug a.i/L (mean measured concentration).	
Copepod *Eudiaptomus graciloides*	48-hr (flow-through)	Abamectin 1.8 % EC (1.8% w/v a.i.nominal; 1.9 % w/v analysed)	EC_{50}: 1.08µg a.i./L (measured concentrations within 87-110% of nominal)	
Amphipod *(Gammarus sp.)*	Acute 48-hr static	Abamectin technical (89.3%)	EC_{50}: 8.6µg a.i./L (mean measured concentrations)	
Rotifer- *Brachiomus calyciflorus*	24-hr (static)	Abamectin technical (89.3% purity)	EC_{50}: 4000 µg a.i./L (mean measured)	
Crustacean- *Thamnocephalus platyurus*			EC_{50}: 2.8 µg a.i./L (mean measured concentrations)	
Great pond snail (*Lymnaea stagnalis*)	Acute 48-hr static	Abamectin technical (89.3%)	EC_{50}: 55 µg a.i./L (mean measured concentrations)	
Mayflye larvae (*Cloeon sp.*)			EC_{50}: 2.9 µg a.i./L (nominal concentration)	
Phantom midges (*Charoborus sp.*)			EC_{50}: 190 µg a.i./L (measured concentrations within 87–99% of nominal)	
Seed shrimp (*Ostracoda*)			EC_{50}: 55 µg a.i./L (nominal concentration)	
Freshwater fish (surrogate for aquatic-phase amphibians)				
Rainbow trout, *Oncorhynchus Mykiss*	96hr-Acute Static	Avermectin B1a (91.43%)	LC_{50}: 3.6 µg a.i./L (nominal)	1238930
	96- hr Acute (flow-through)	abamectin (86.2% w/w) (96.2% w/w on a dry basis)	LC_{50}**:** 8.7 µg a.i./L (initial measured concentrations).	3019907

Organism	Exposure	Test substance	Endpoint value	PMRA #
	96- hr Acute (semi-static)	Abamectin 1.8% EC (analysed purity 1.695% w/v)	LC_{50} = 2.6 µg a.i./L (151 µg product/L) (mean measured concentration)	3019905
	96- hr Acute (flow-through)	8,9-Z-avermectin B1a (NOA 427011)	LC_{50}: 5.4 µg./L (mean measured concentrations).	3019907
	96- hr Acute (static renewal)	8a-oxo-avermectin B1a (NOA 448111) (91% w/w)	LC_{50}: 121 µg./L (time-weighted average concentrations).	937803
		8a-hydroxy-avermectin B1a (NOA 448112) (91.7% w/w)	LC_{50}: 520 µg./L (mean measured concentrations).	937804
Bluegill sunfish *Lepomis macrochirus*	96hr-Acute Static	abamectin (91.43%)	LC_{50}: 6.7 µg a.i./L (nominal)	1238934
Channel catfish *Ictalurus punctatus*	96hr-Acute Static	abamectin (91% w/w)	LC_{50}: 24 µg a.i./L (nominal concentration)	1238937
Fathead minnow *Pimephales promelas*	96-hr Acute (flow-through)	abamectin (86.2% w/w) (96.2% w/w on a dry basis)	LC_{50}: 14.7 µg a.i./L (mean measured concentrations).	3019907
Zebrafish *Danio rerio*	96-hr Acute (semi-static)	abamectin Tech. (93%)	LC_{50}**:** 34 µg a.i./L (nominal concentrations).	
	48hr Acute (semi-static)	abamectin Tech. (98.6%)	LC_{50}**:** 59 µg a.i./L (nominal concentrations).	3087548
Rainbow trout, *Oncorhynchus Mykiss*	60 d Early life stage toxicity (flow-through)	Abamectin technical (91% w/w purity)	NOEC: 0.52 µg a.i./L (mean measured concentrations)	1238931
Common Carp (*Cyrinus carpio*)	28-d chronic (flow-through)	Abamectin Technical (89.3%)	NOEC: 6.1 µg a.i./L (mean measured concentrations)	3019907
Amphibians				
African Clawed frog *(Xenopus laevis)*	21- d metamorphosis assay (flow-through)	Abamectin Technical (98% w/w)	NOEC: 9.6 µg a.i./L (mean measured concentration)	3019907
Freshwater algae				
Green alga *Desmodesmus subspicatus*	72 hr-Acute Static	Abamectin 1.8% EC (1.8% w/v)	EbC_{50}: 518 µg a.i. /L (25.9 mg product/L) (mean measured concentrations)	3019907
		8a-oxo-avermectin B1a (NOA 448111) (97.7% w/w)	ErC_{50}: >100000 µg /L (nominal concentrations)	
		4, 8a-dihydroxy-avermectin B1a (NOA 457464) (99.7% w/w)	ErC_{50}: 34100 µg /L (mean measured concentrations)	
		4-hydroxy-8a-oxo-avermectin B1a (NOA 457465) (94.4% w/w)	EyC_{50}: 16500 µg /L (mean measured concentrations)	
Green algae *Selenastrum capricornutum*	72- hr (static)	8,9-Z-avermectin B1a (NOA 427011) (87.6% w/w)	ErC_{50}: >9000 µg /L (mean measured concentrations)	

Organism	Exposure	Test substance	Endpoint value	PMRA #
	72-hr Acute (static limit test)	8a-hydroxy-avermectin B1a (NOA 448112) (91.7% w/w)	ErC_{50}: >6100 µg /L (mean measured concentrations)	
Diatom *Navicula pelliculosa*	96 hr-Acute Static	Abamectin technical (98%)	72 hr EyC_{50}: 750 µg a.i./L (measured concentration)	2298713
Estuarine/marine invertebrates				
Mysid shrimp *Mysidopsis bahia*	96hr-Acute (flow-through)	^{3}H-avermectin B1a	EC_{50}: 0.022 µg a.i./L (mean measured concentrations)	1238960
			LC_{50}: 0.023 µg a.i./L (mean measured concentration)	1238962
Embryos-larvae of Eastern Oysters (*Crassostrea virginica*)	48hr-Acute (Static)	Abamectin technical (90.5% purity)	EC_{50}: 430 µg a.i./L (nominal concentration)	1238955
Northern Pink shrimp *Penaeus duorarum*	96- h Acute (static)		EC_{50}: 1.6 µg a.i./L (nominal concentrations)	1238956
Blue crab *Callinectes sapidus*			EC_{50}: 153 µg a.i./L (nominal concentrations)	1238957, 1238958
Mysid shrimp *Mysidopsis bahia*	28d-Chronic (Flow-through)	^{3}H-avermectin B1a (96.3% purity)	NOEC: 0.0022 µg a.i./L (mean measured concentration)	2716588, 2717210
Estuarine/marine fish				
Sheepshead minnows *Cyprinodon variegatus*	96hr-Acute Static	Abamectin (91% w/w)	LC_{50}: 15 µg a.i./L (nominal concentrations).	1238959
	34d- early life stage Flow through	Abamectin Tech (98.0%)	NOEC: 0.34 µg a.i./L (larval survival) (mean measured concentrations)	2298743
Estuarine/marine alga				
Marine Diatom *Skeletonema costatum*	72hr-Acute Static	Abamectin 98% purity	72 hour EbC_{50}: 110 µg a.i./L (measured concentrations)	229728

[a] USEPA classification, where applicable; n/a, not applicable.

Table 6 Screening level risk assessment: Terrestrial invertebrates and plants

Organism	Substance	Exposure	Endpoint value	EEC[a]	RQ	Level of Concern exceeded?
Invertebrates						
Earthworm, *Eisenia fetida*	Avermectin B1a	14d -acute	$LC_{50}/2$ = 16.50 mg a.i./kg	0.050 mg a.i./kg dw soil	0.003	No[b]
Springtail Collembolan (*Folsomia candida)*	Abamectin 1.8% EC	28d -acute	$LC_{50}/2$ = 0.97 mg a.i./kg dw soil	0.050 mg a.i./kg dw soil	0.052	No[b]

Organism	Substance	Exposure	Endpoint value	EEC[a]	RQ	Level of Concern exceeded?
Earthworm, *Eisenia fetida*	Abamectin 1.8% EC	56d -Chronic	NOEC <0.072 mg a.i./kg dw soil	0.050 mg /kg dw soil	>0.69	No[b]
	Vertimec 0.18 EC		NOEC: 0.72 mg a.i./kg		0.07	No[b]
Springtail Collembolan (*Folsomia candida)*	Abamectin	28d -Chronic	NOEC = 0.103 mg a.i./kg dw soil	0.050 mg /kg dw soil	0.49	No[b]
Adult Honeybee, *Apis meliffera*	Abamectin	24hr contact	LD_{50} = 0.001 µg a.i./bee	0.0286 kg a.i/ha × 2.4 µg a.i./bee per kg/ha = 0.069 µg a.i./bee	**68.6**	**Yes**[c]
	Abamectin	72hr oral	LD_{50} = 0.007 µg a.i./bee	0.0286 kg a.i./ha × 29 µg a.i./bee per kg/ha = 0.818 µg a.i./bee/day	**163**	**Yes**[c]
	Abamectin 1.8% EC	10-d chronic	NOED = 0.000102 µg a.i./bee/day	0.0286 kg a.i./ha × 29 µg a.i./bee per kg/ha = 0.818 µg a.i./bee/day	**802**	**Yes**[c]
Larva Honeybee, *Apis meliffera*	Abamectin	8-d acute	LD_{50}=0.00012 µg a.i./larva	0.0286 kg a.i./ha × 12 µg a.i./bee per kg/ha = 0.348 µg a.i./bee	**2896**	**Yes**[c]
	Abamectin	22d-chronic (pupal survival and adult emergence)	NOED = 0.00001 µg a.i./bee/day	0.0286 kg a.i./ha × 12 µg a.i./bee per kg/ha = 0.348 µg a.i./bee	**34755**	**Yes**[c]
Parasitoid, *Aphidius rhopalosiphi*	Vertimec 018 EC	48hr acute, extended spray residues	LR_{50} = 0.143 g a.i./ha	On-field: cumulative rate: 56.1 g a.i./ha Off-field : ground application,fine droplets, 11% of rate: 6.179 g a.i./ha Off-field : airblast application, fine droplets, early season 74% of rate: 41.5 g a.i./ha	**On-field: 392.2**	**Yes**[c]
					Off-field ground: 43.1	**Yes**[c]
					Off-field E.airblast: 290.3	**Yes**[c]
					Off-field L airblast: 231.4	**Yes**[c]
Predatory mite, *Typhlodromus pyri*	Abamectin 1.8% EC	14-d acute, extended spray residues	LR_{50} = 0.182 g a.i./ha	Off-field : airblast application, fine droplets, late season 59% of rate: 33.1 g a.i./ha	**On-field: 308.2**	**Yes**[c]
					Off-field ground: 33.9	**Yes**[c]
					Off-field E.airblast: 228.1	**Yes**[c]
					Off-field L airblast: 181.8	**Yes**[c]
Parasitoid, *Aphidius rhopalosiphi*	Vertimec 018 EC	48hr acute, extended spray residues	LR_{50} = 0.143 g a.i./ha	On-field: minimum single rate: 14.14 g a.i./ha Off-field : ground application,fine droplets, 11% of rate: 1.55 g a.i./ha	**On-field: 98.9**	**Yes**[c]
					Off-field ground: 10.9	**Yes**[c]
					Off-field E.airblast: 73.2	**Yes**[c]
					Off-field L airblast:	**Yes**[c]

Organism	Substance	Exposure	Endpoint value	EEC[a]	RQ	Level of Concern exceeded?
				Off-field : airblast application, fine droplets, early season 74% of rate: 10.46 g a.i./ha Off-field : airblast application, fine droplets, late season 59% of rate: 8.34 g a.i./ha	**58.3**	
Predatory mite, *Typhlodromus pyri* (eggs)	Abamectin EC	14d acute, extended spray residues	LR_{50} = 0.182 g a.i./ha		**On-field: 77.7**	**Yes[c]**
					Off-field ground: 8.5	**Yes[c]**
					Off-field E.airblast: 57.5	**Yes[c]**
					Off-field L airblast: 45.8	**Yes[c]**
Adult Carabid beetle *Poecilus cupreus*	Vertimec 018 EC	14-d acute, extended spray residues	LR_{50}>58 g a.i./ha		On-field: <0.97	No[b]
	8a-hydroxy-avermectin B1a	14d chronic soil	NOEC=0.146 mg/kg dw soil	0.051 mg /kg dw soil	0.349	No[b]
Soil predatory mite *(Hypoaspis aculeifer)*	Abamectin 1.8% EC	14-d acute soil	LC_{50} >19.4 mg /kg dw soil	0.050 mg /kg dw soil	<0.003	No[b]
Vascular plants						
Terrestrial plants	Abamectin 1.8% EC	14d Vegetative vigour	ER_{25}>49.5 g a.i/ha	In-field: cumulative rate: 56.1 g a.i./ha	<1.13	No[c]

Bolded cells indicate RQ exceeds the LOC (level of concern).
[a]For contact exposure, the exposure estimate = (2.4 µg a.i./bee)*(application rate in kg a.i./ha); dietary factors are 29 µg a.i./bee (adult) and 12 µg a.i./bee (larva).
[b]The cumulative soil rate of 103.202 g a.i/ha (22.8 g a.i./ha × 6 times with a 7 day interval and 40 days soil half-life).
[c]The cumulative foliar rate of 56.1 g a.i/ha (22.8 g a.i./ha × 6 times with a 7 day interval and 10 days foliar dissipation). LOC of 0.4 and 1.0 for acute and chronic pollinator risk assessment, respectively..

Table 7 Tier I refined risk assessment of abamectin for adult and larval bees using residues measured in pollen, nectar and flower at application rate of 25.85 g a.i./ha on full-flowering *Phacelia* under semi-field conditions

Residues (mg/kg) Day 1: pollen =0.016; nectar <LOQ (<0.01), ½ LOQ=0.005				**Residues (mg/kg) Day 1: pollen =0.016 also as surrogate for nectar residues**				**Residues (mg/kg) Day 4: pollen and nectar residues (<LOQ=10 mg/kg)**				**Residues (mg/kg) Day 0: flower residues as surrogate for pollen and nectar (3.5mg/kg)**			
Adult Exposure	RQs	Larvae Exposure	RQs	Adult Exposure	RQs	Larvae Exposure	RQs	Adult Exposure	RQs	Larvae Exposure	RQs	Adult Exposure	RQs	Larvae Exposure	RQs
acute	0.2	acute	**5.5**	acute	**0.7**	acute	**16.5**	acute	**0.43**	acute	**10**	acute	**146**	acute	**3605**
chronic	**14.3**	chronic	**65.8**	chronic	**45.8**	chronic	**198**	chronic	**29**	chronic	**124**	chronic	**10021**	chronic	**43260**

Note: Adult bee endpoints: acute oral: 0.007 µg a.i./bee; chronic oral: 0.000102 µg a.i./bee; Larval bee endpoints: acute oral: 0.00012 µg a.i./larvae; chronic oral: 0.00001 µg a.i./bee
+ acute LOC is 0.4
++ chronic LOC is 1.0
Bolded cells indicate RQ exceeds the LOC (level of concern)

Table 8 Refined risk assessment of abamectin for beneficial arthropods using in-field foliar interception and off-field vegetation distribution factors on the maximum cumulative application rate on outdoor ornamentals

Organism	Exposure	Endpoint	EEC	RQ	LOC exceeded
Maximum cumulative application rate on outdoor ornamentals					
Parasitoid, *Aphidius rhopalosiphi*	On – field[1] 48hr acute, extended spray residues	LR_{50}= 0.143 g a.i./ha	22.44 g a.i./ha	**156.9**	**Yes**
	Off-field [2]: ground application,fine droplets, 11% of rate		0.62 g a.i./ha	**4.3**	**Yes**
	Off-field [2]: airblast application, fine droplets, early season 74% of rate:		4.15 g a.i./ha	**29**	**Yes**
	Off-field [2]: airblast application, fine droplets, late season 59% of rate		3.31 g a.i./ha	**23**	**Yes**
Typhlodromus pyri (predatory mite)	On-field[1] 14d acute, extended spray residues	LR_{50}= 0.182 g a.i./ha	22.44 g a.i./ha	**123.3**	**Yes**
	Off-field [2]: ground application,fine droplets, 11% of rate		0.62 g a.i./ha	**3.4**	**Yes**
	Off-field [2]: airblast application, fine droplets, early season 74% of rate:		4.15 g a.i./ha	**22.8**	**Yes**
	Off-field [2]: airblast application, fine droplets, late season 59% of rate		3.31 g a.i./ha	**18.2**	**Yes**
Predatory bug, *Orius laevigatus*	On-field[1] 9-d acute, extended spray residues	LR_{50}= 1.67 g a.i./ha	22.44 g a.i./ha	**13.4**	**Yes**
	Off-field [2]: ground application,fine droplets, 11% of rate		0.62 g a.i./ha	0.4	No
	Off-field [2]: airblast application, fine droplets, early season 74% of rate:		4.15 g a.i./ha	**2.5**	**Yes**
	Off-field [2]: airblast application, fine droplets, late season 59% of rate		3.31 g a.i./ha	**2.0**	**Yes**

Organism	Exposure	Endpoint	EEC	RQ	LOC exceeded
Minimum single application rate on apples					
Parasitoid, *Aphidius rhopalosiphi*	On – field[1] 48h acute, extended spray residues	LR_{50}=0.143 g a.i./ha	5.7 g a.i./ha	**39.5**	**Yes**
	Off-field[2] : ground application,fine droplets, 11% of rate		0.16 g a.i./ha	**1.09**	**Yes**
	Off-field [2]: airblast application, fine droplets, early season 74% of rate:		1.05 g a.i./ha	**7.3**	**Yes**
	Off-field [2]: airblast application, fine droplets, late season 59% of rate		0.83 g a.i./ha	**5.8**	**Yes**
Typhlodromus pyri (predatory mite)	On-field[1] 14d acute, extended spray residues	LR_{50}=0.182 g a.i./ha	5.7 g a.i./ha	**31**	**Yes**
	Off-field [2]: ground application,fine droplets, 11% of rate		0.16 g a.i./ha	0.9	No
	Off-field [2]: airblast application, fine droplets, early season 74% of rate:		1.05 g a.i./ha	**5.7**	**Yes**
	Off-field [2]: airblast application, fine droplets, late season 59% of rate		0.83 g a.i./ha	**4.6**	**Yes**
Predatory bug, *Orius laevigatus*	On-field[1] 9-d acute, extended spray residues	LR_{50}=1.67 g a.i./ha	5.7 g a.i./ha	**3.4**	**Yes**
	Off-field [2]: ground application,fine droplets, 11% of rate		0.16 g a.i./ha	0.1	No
	Off-field [2]: airblast application, fine droplets, early season 74% of rate:		1.05 g a.i./ha	0.6	No
	Off-field [2]: airblast application, fine droplets, late season 59% of rate		0.83 g a.i./ha	0.5	No

Bolded cells indicate RQ exceeds the LOC (level of concern)

[1] on-field EEC = cumulative application rate × crop interception factor (40%); post bloom application

[2] Off-field EEC = application rate × drift factor (11% for field sprayer application; 74% for early airblast and 59% for late airblast) × vegetation distribution factor of 10%.

The vegetation distribution factor is applied since drift is overestimated to the lower or interior portions of a three-dimensional habitat structure. Most of the drift would be intercepted by the top or side portions of the habitat.

Table 9 Screening level risk assessment of abamectin for birds and mammals, foliar application at multiple rates of 22.8 g a.i./ha × 6 and 7 day interval

	Toxicity (mg a.i./kg bw/d)	Feeding guild (food item)	EDE* (mg a.i./kg bw)	RQ
Small bird (0.02 kg)				
Acute	2.60	Insectivore	4.13	**1.76**
Reproduction	0.70	Insectivore	4.13	**6.52**
Medium sized bird (0.1 kg)				
Acute	2.60	Insectivore	3.23	**1.37**
Reproduction	0.70	Insectivore	3.23	**5.09**
Large Sized Bird (1 kg)				
Acute	2.60	Herbivore (short grass)	2.08	0.89
Reproduction	0.70	Herbivore (short grass)	2.08	**3.29**
Small mammal (0.015 kg)				
Acute	0.87	Insectivore	2.38	**3.02**
Reproduction	0.12	Insectivore	2.38	**21.88**
Medium sized mammal (0.035 kg)		Insectivore		
Acute	0.87	Herbivore (short grass)	4.61	**5.84**
Reproduction	0.12	Herbivore (short grass)	4.61	**42.44**
Large sized mammal (1 kg				
Acute	0.87	Herbivore (short grass)	2.46	**3.13**
Reproduction	0.12	Herbivore (short grass)	2.46	**22.68**

Bolded cells indicate RQ exceeds the LOC (level of concern)
*EDE = Estimated dietary exposure; is calculated using the following formula: (FIR/bw) × EEC, where:
FIR: Food Ingestion Rate. For generic birds with body weight less than or equal to 200 g, the "passerine" equation was used; for generic birds with body weight greater than 200 g, the "all birds" equation was used:
Passerine Equation (body weight <or = 200 g): FIR (g dry weight/day) = $0.398(\text{bw in g})^{0.850}$
All birds Equation (body weight >200 g): FIR (g dry weight/day) = 0.648 (bw in g) 0.651
For mammals, the "all mammals" equation was used: FIR (g dry weight/day) = $0.235(\text{bw in g})^{0.822}$
bw: Generic Body Weight
EEC: Concentration of pesticide on food item. At the screening level, relevant food items representing the most conservative EEC for each feeding guild are used.

Table 10 Refined avian risk assessment using maximum and mean abamectin residue values on the maximum cumulative rate on outdoor ornamentals at 56 g a.i/ha (22.8 g a.i./ha × 10 days (foliar half-life) × 6 applications × 7 days interval) while considering 11% drift for ground application, 74% drift for early airblast application and 59% for late airblast application

			Maximum nomogram residues				Mean nomogram residues											
			On-field		Off Field		On-field			Off Field (ground application - 11% drift)		Off Field (early airblast application – 74% drift)			Off Field (late airblast application – 59% drift)		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
Small bird (0.02 kg)																	
Acute	2.60	Insectivore	4.57	**1.76**	0.50	0.19	3.15	**1.21**	83	0.35	0.13	2.33	0.90	-	1.86	0.72	-
	2.60	Granivore (grain and seeds)	0.71	0.27	0.08	0.03	0.34	0.13	-	0.04	0.01	0.25	0.10	-	0.20	0.08	-
	2.60	Frugivore (fruit)	1.41	0.54	0.16	0.06	0.67	0.26	-	0.07	0.03	0.50	0.19	-	0.40	0.15	-
Reproduction	0.70	Insectivore	4.54	**6.52**	0.50	0.72	3.15	**4.50**		0.35	0.50	2.33	**3.33**	30	1.86	**2.66**	38
	0.70	Granivore (grain and seeds)	0.71	**1.01**	0.08	0.11	0.34	0.48	-	0.04	0.05	0.25	0.36	-	0.20	0.28	-
	0.70	Frugivore (fruit)	1.41	**2.02**	0.16	0.22	0.67	0.96	-	0.07	0.11	0.50	0.71	-	0.40	0.57	-
Medium sized bird (0.1 kg)																	
Acute	2.60	Insectivore	3.56	1.**37**	0.39	0.15	2.46	0.95	-	0.27	0.10	1.82	0.70	-	1.45	0.56	-
	2.60	Granivore (grain and seeds)	0.55	0.21	0.06	0.02	0.26	0.10	-	0.03	0.01	0.19	0.07	-	0.16	0.06	-
	2.60	Frugivore (fruit)	1.10	0.42	0.12	0.05	0.53	0.20	-	0.06	0.02	0.39	0.15	-	0.31	0.12	-
Reproduction	0.70	Insectivore	3.56	**5.09**	0.39	0.56	2.46	**3.51**	28	0.27	0.39	1.82	**2.60**	39	1.45	**2.07**	48
	0.70	Granivore (grain and seeds)	0.55	0.79	0.06	0.09	0.26	0.38	-	0.03	0.04	0.19	0.28	-	0.16	0.22	-
	0.70	Frugivore (fruit)	1.10	**1.58**	0.12	0.17	0.53	0.75	-	0.06	0.08	0.39	0.56	-	0.31	0.44	-
Large sized bird (1 kg)																	
Acute	2.60	Insectivore	1.04	0.40	0.11	0.04	0.72	0.28	-	0.08	0.03	0.53	0.20	-	0.42	0.16	-
	2.60	Granivore (grain and seeds)	0.16	0.06	0.02	0.01	0.72	0.28	-	0.01	0.00	0.06	0.02	-	0.05	0.02	-
	2.60	Frugivore (fruit)	0.32	0.12	0.04	0.01	0.15	0.06	-	0.02	0.01	0.11	0.04	-	0.09	0.03	-
	2.60	Herbivore (short grass)	2.30	0.89	0.25	0.10	0.82	0.31	-	0.09	0.03	0.60	0.23	-	0.48	0.19	-
	2.60	Herbivore (long grass)	1.41	0.54	0.15	0.06	0.46	0.18	-	0.05	0.02	0.34	0.13	-	0.27	0.10	-
	2.60	Herbivore (Broadleaf plants)	2.13	0.82	0.23	0.09	0.70	0.27	-	0.08	0.03	0.52	0.20	-	0.42	0.16	-
Reproduction	0.70	Insectivore	1.04	**1.49**	0.11	0.16	0.72	**1.03**	97	0.08	0.11	0.53	0.76	-	0.42	0.61	-
	0.70	Granivore (grain and seeds)	0.16	0.23	0.02	0.03	0.72	**1.03**	97	0.01	0.01	0.06	0.08	-	0.05	0.06	-
	0.70	Frugivore (fruit)	0.32	0.46	0.04	0.05	0.15	0.22	-	0.02	0.02	0.11	0.16	-	0.09	0.13	-
	0.70	Herbivore (short grass)	2.30	**3.29**	0.25	0.36	0.82	**1.17**	85	0.09	0.13	0.60	0.86	-	0.48	0.69	-
	0.70	Herbivore (long grass)	1.41	**2.01**	0.15	0.22	0.46	0.66	-	0.05	0.07	0.34	0.49	-	0.27	0.39	-
	0.70	Herbivore (Broadleaf plants)	2.13	**3.04**	0.23	0.33	0.70	**1.01**	99	0.08	0.11	0.52	0.74	-	0.42	0.59	-

Bolded cells indicate RQ exceeds the LOC (level of concern).

Table 11 Refined mammalian risk assessment using maximum and mean abamectin residue values on the highest application rate on outdoor ornamentals (at 22.8 g a.i./ha × 10 days (foliar half-life) × 6 applications × 7 days interval) while considering 11% drift for ground application

			NOEL Values								LOEL Values									
			Maximum nomogram residues				Mean nomogram residues				Maximum nomogram residues				Mean nomogram residues					
			On-field		Off field		On-field		Off field		On-field		Off field		On-field			Off field		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
Small mammal (0.015 kg)																				
Acute	0.87	Insectivore	2.63	**3.02**	0.29	0.33	1.81	**2.08**	0.20	0.23	2.63	**3.02**	0.29	0.33	1.81	**2.08**	48	0.20	0.23	-
	0.87	Granivore (grain and seeds)	0.41	0.47	0.04	0.05	0.19	0.22	0.02	0.02	0.41	0.47	0.04	0.05	1.81	0.22	-	0.02	0.02	-
	0.87	Frugivore (fruit)	0.81	0.93	0.09	0.10	0.39	0.45	0.04	0.05	0.81	0.93	0.09	0.10	0.19	0.45	-	0.04	0.05	-
Reproduction	0.12	Insectivore	2.63	**21.88**	0.29	**2.41**	1.81	**15.11**	0.20	**1.66**	2.63	**6.56**	0.29	0.72	0.39	**4.53**	22	0.20	0.50	-
	0.12	Granivore (grain and seeds)	0.41	**3.39**	0.04	0.37	0.19	**1.62**	0.02	0.18	0.41	**1.02**	0.04	0.11	1.81	0.48	-	0.02	0.05	-
	0.12	Frugivore (fruit)	0.81	**6.77**	0.09	0.75	0.39	**3.23**	0.04	0.36	0.81	**2.03**	0.09	0.22	0.19	0.97	-	0.04	0.11	-
Medium sized mammal (0.035 kg)																				
Acute	0.87	Insectivore	2.30	**2.65**	0.25	0.29	1.59	**1.83**	0.17	0.20	2.30	**2.65**	0.25	0.29	1.59	**1.83**	55	0.17	0.20	-
	0.87	Granivore (grain and seeds)	0.36	0.41	0.04	0.05	0.17	0.20	0.02	0.02	0.36	0.41	0.04	0.05	0.17	0.20	-	0.02	0.02	-
	0.87	Frugivore (fruit)	0.71	0.82	0.08	0.09	0.34	0.93	0.04	0.04	0.71	0.82	0.08	0.09	0.34	0.39	-	0.04	0.04	-
	0.87	Herbivore (short grass)	5.09	**5.85**	0.56	0.64	1.81	**2.08**	0.20	0.23	5.09	**5.85**	0.56	0.64	1.81	**2.08**	48	0.20	0.23	-
	0.87	Herbivore (long grass)	3.11	**3.57**	0.34	0.39	1.02	**1.17**	0.11	0.13	3.11	**3.57**	0.34	0.39	1.02	**1.17**	86	0.11	0.13	-
	0.87	Herbivore (forage crops)	4.71	**5.42**	0.52	0.60	1.56	**1.79**	0.17	0.20	4.71	**5.42**	0.52	0.60	1.56	**1.79**	56	0.17	0.20	-
Reproduction	0.12	Insectivore	2.30	**19.18**	0.25	**2.11**	1.59	**13.25**	0.17	**1.46**	2.30	**5.75**	0.25	0.63	1.59	**3.97**	25	0.17	0.44	-
	0.12	Granivore (grain and seeds)	0.36	**2.97**	0.04	0.33	0.17	**1.42**	0.02	0.16	0.36	0.89	0.04	0.10	0.17	0.42	-	0.02	0.05	-
	0.12	Frugivore (fruit)	0.71	**5.94**	0.08	0.65	0.34	**2.83**	0.04	0.31	0.71	**1.78**	0.08	0.20	0.34	0.85	-	0.04	0.09	-
	0.12	Herbivore (short grass)	5.09	**42.44**	0.56	**4.67**	1.81	**15.07**	0.20	**1.66**	5.09	**12.73**	0.56	**1.40**	1.81	**4.52**	22	0.20	0.50	-
	0.12	Herbivore (long grass)	3.11	**25.91**	0.34	**2.85**	1.02	**8.46**	0.11	0.93	3.11	**7.77**	0.34	0.86	1.02	**2.54**	39	0.11	0.28	-

			NOEL Values								LOEL Values									
			Maximum nomogram residues				Mean nomogram residues				Maximum nomogram residues				Mean nomogram residues					
			On-field		Off field		On-field		Off field		On-field		Off field		On-field			Off field		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
	0.12	Herbivore (Broadleaf plants)	4.71	39.27	0.52	**4.32**	1.56	**12.98**	0.17	**1.43**	4.71	**11.78**	0.52	**1.30**	1.56	**3.89**	26	0.17	0.43	-
Large sized mammal (1 kg)																				
Acute	0.87	Insectivore	1.23	**1.41**	0.14	0.16	0.85	0.98	0.09	0.11	1.23	**1.41**	0.14	0.16	0.85	0.98	-	0.09	0.11	-
	0.87	Granivore (grain and seeds)	0.19	0.22	0.02	0.02	0.09	0.10	0.01	0.01	0.19	0.22	0.02	0.02	0.09	0.10	-	0.01	0.01	-
	0.87	Frugivore (fruit)	0.38	0.44	0.04	0.05	0.18	0.21	0.02	0.02	0.38	0.44	0.04	0.05	0.18	0.21	-	0.02	0.02	-
	0.87	Herbivore (short grass)	2.72	**3.13**	0.30	0.34	0.97	**1.11**	0.11	0.12	2.72	**3.13**	0.30	0.34	0.97	**1.11**	90	0.11	0.12	-
	0.87	Herbivore (long grass)	1.66	**1.91**	0.18	0.21	0.54	0.62	0.06	0.07	1.66	**1.91**	0.18	0.21	0.54	0.62	-	0.06	0.07	-
	0.87	Herbivore (Broadleaf plants)	2.52	**2.89**	0.28	0.32	0.83	0.96	0.09	0.11	2.52	**2.89**	0.28	0.32	0.83	0.96	-	0.09	0.11	-
Reproduction	0.12	Insectivore	1.23	**10.25**	0.14	1.**13**	0.85	**7.08**	0.09	0.78	1.23	**3.07**	0.14	0.34	0.85	**2.12**	47	0.09	0.23	-
	0.12	Granivore (grain and seeds)	0.19	**1.59**	0.02	0.17	0.09	0.76	0.01	0.08	0.19	0.48	0.02	0.05	0.09	0.23	-	0.01	0.02	-
	0.12	Frugivore (fruit)	0.38	**3.17**	0.04	0.35	0.18	**1.51**	0.02	0.17	0.38	0.95	0.04	0.10	0.18	0.45	-	0.02	0.05	-
	0.12	Herbivore (short grass)	2.72	**22.68**	0.30	**2.49**	0.97	**8.05**	0.11	0.08	2.72	**6.80**	0.30	0.75	0.97	**2.42**	41	0.11	0.27	-
	0.12	Herbivore (long grass)	1.66	**13.85**	0.18	**1.52**	0.54	**4.52**	0.06	0.17	1.66	**4.15**	0.18	0.46	0.54	**1.36**	74	0.06	0.15	-
	0.12	Herbivore (Broadleaf plants)	2.52	**20.98**	0.28	**2.31**	0.83	**6.94**	0.09	0.89	2.52	**6.29**	0.28	0.69	0.83	**2.08**	48	0.09	0.23	-

Bolded cells indicate RQ exceeds the LOC (level of concern)

Table 12 Refined mammalian risk assessment using maximum and mean abamectin residue values on the highest application rate on outdoor ornamentals (at 22.8 g a.i./ha × 10 days (foliar half-life) × 6 applications × 7 days interval) while considering 74% drift for early airblast application

			NOEL Values								LOEL Values									
			Maximum nomogram residues				Mean nomogram residues				Maximum nomogram residues				Mean nomogram residues					
			On-field		Off field		On-field		Off field		On-field		Off field		On-field			Off field		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
Small mammal (0.015 kg)																				
Acute	0.87	Insectivore	2.63	**3.02**	1.94	**2.23**	1.81	**2.08**	1.34	**1.54**	2.63	**3.02**	1.94	**2.23**	1.81	**2.08**	48	1.34	**1.54**	65
	0.87	Granivore (grain and seeds)	0.41	0.47	0.30	0.35	0.19	0.22	0.14	0.16	0.41	0.47	0.30	0.35	0.19	0.22	-	0.14	0.16	-
	0.87	Frugivore (fruit)	0.81	0.93	0.60	0.69	0.39	0.45	0.29	0.33	0.81	0.93	0.60	0.69	0.39	0.45	-	0.29	0.33	-
Reproduction	0.12	Insectivore	2.63	**21.88**	1.94	**16.19**	1.81	**15.11**	1.34	**11.18**	2.63	**6.56**	1.94	**4.86**	1.81	**4.53**	22	1.34	**3.35**	30
	0.12	Granivore (grain and seeds)	0.41	**3.39**	0.30	**2.51**	0.19	**1.62**	0.14	**1.20**	0.41	**1.02**	0.30	0.75	0.19	0.48	-	0.14	0.36	-
	0.12	Frugivore (fruit)	0.81	**6.77**	0.60	**5.01**	0.39	**3.23**	0.29	**2.39**	0.81	**2.03**	0.60	**1.50**	0.39	0.97	-	0.29	0.72	-
Medium sized mammal (0.035 kg)																				
Acute	0.87	Insectivore	2.30	**2.65**	1.70	**1.96**	1.59	**1.83**	1.18	**1.35**	2.30	**2.65**	1.70	**1.96**	1.59	**1.83**	55	1.18	**1.35**	74
	0.87	Granivore (grain and seeds)	0.36	0.41	0.26	0.30	0.17	0.20	0.13	0.14	0.36	0.41	0.26	0.30	0.17	0.20	-	0.13	0.14	-
	0.87	Frugivore (fruit)	0.71	0.82	0.53	0.61	0.34	0.39	0.25	0.29	0.71	0.82	0.53	0.61	0.34	0.39	-	0.25	0.29	-
	0.87	Herbivore (short grass)	5.09	**5.85**	3.77	**4.33**	1.81	**2.08**	1.34	**1.54**	5.09	**5.85**	3.77	**4.33**	1.81	**2.08**	48	1.34	**1.54**	65
	0.87	Herbivore (long grass)	3.11	**3.57**	2.30	**2.64**	1.02	**1.17**	0.75	0.86	3.11	**3.57**	2.30	**2.64**	1.02	**1.17**	86	0.75	0.86	-
	0.87	Herbivore (forage crops)	4.71	**5.42**	3.49	**4.01**	1.56	**1.79**	1.15	**1.32**	4.71	**5.42**	3.49	**4.01**	1.56	**1.79**	56	1.15	**1.32**	76
Reproduction	0.12	Insectivore	2.30	**19.18**	1.70	**14.20**	1.59	**13.25**	1.18	**9.80**	2.30	**5.75**	1.70	**4.26**	1.59	**3.97**	25	1.18	**2.94**	34
	0.12	Granivore (grain and seeds)	0.36	**2.97**	0.26	**2.20**	0.17	**1.42**	0.13	**1.05**	0.36	0.89	0.26	0.66	0.17	0.42	-	0.13	0.31	-
	0.12	Frugivore (fruit)	0.71	**5.94**	0.53	**4.39**	0.34	**2.83**	0.25	**2.10**	0.71	**1.78**	0.53	**1.32**	0.34	0.85	-	0.25	0.63	-
	0.12	Herbivore (short grass)	5.09	**42.44**	3.77	**31.41**	1.81	**15.07**	1.34	**11.15**	5.09	**12.73**	3.77	**9.42**	1.81	**4.52**	22	1.34	**3.35**	30
	0.12	Herbivore (long grass)	3.11	**25.91**	2.30	**19.18**	1.02	**8.46**	0.75	**6.26**	3.11	**7.77**	2.30	**5.75**	1.02	**2.54**	39	0.75	**1.88**	53
	0.12	Herbivore (Broadleaf plants)	4.71	**39.27**	3.49	**29.06**	1.56	**12.98**	1.15	**9.61**	4.71	**11.78**	3.49	**8.72**	1.56	**3.89**	26	1.15	**2.88**	35

			NOEL Values								LOEL Values									
			Maximum nomogram residues				Mean nomogram residues				Maximum nomogram residues				Mean nomogram residues					
			On-field		Off field		On-field		Off field		On-field		Off field		On-field			Off field		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
Large sized mammal (1 kg)																				
Acute	0.87	Insectivore	1.23	**1.41**	0.91	**1.05**	0.85	0.98	0.63	0.72	1.23	**1.41**	0.91	**1.05**	0.85	0.98	-	0.63	0.72	-
	0.87	Granivore (grain and seeds)	0.19	0.22	0.14	0.16	0.09	0.10	0.07	0.08	0.19	0.22	0.14	0.16	0.09	0.10	-	0.07	0.08	-
	0.87	Frugivore (fruit)	0.38	0.44	0.28	0.32	0.18	0.21	0.13	0.15	0.38	0.44	0.28	0.32	0.18	0.21	-	0.13	0.15	-
	0.87	Herbivore (short grass)	2.72	**3.13**	2.01	**2.31**	0.97	**1.11**	0.72	0.82	2.72	**3.13**	2.01	**2.31**	0.97	**1.11**	90	0.72	0.82	-
	0.87	Herbivore (long grass)	1.66	**1.91**	1.23	**1.41**	0.54	0.62	0.40	0.46	1.66	**1.91**	1.23	**1.41**	0.54	0.62	-	0.40	0.46	-
	0.87	Herbivore (Broadleaf plants)	2.52	**2.89**	1.86	**2.14**	0.83	0.96	0.62	0.71	2.52	**2.89**	1.86	**2.14**	0.83	0.96	-	0.62	0.71	-
Reproduction	0.12	Insectivore	1.23	**10.25**	0.91	**7.58**	0.85	**7.08**	0.63	**5.24**	1.23	**3.07**	0.91	**2.28**	0.85	**2.12**	47	0.63	**1.57**	64
	0.12	Granivore (grain and seeds)	0.19	**1.59**	0.14	**1.17**	0.09	0.76	0.07	0.56	0.19	0.48	0.14	**0.35**	0.09	0.23	-	0.07	0.17	-
	0.12	Frugivore (fruit)	0.38	**3.17**	0.28	**2.35**	0.18	**1.51**	0.13	**1.12**	0.38	0.95	0.28	0.70	0.18	0.45	-	0.13	0.34	-
	0.12	Herbivore (short grass)	2.72	**22.68**	2.01	**16.78**	0.97	**8.05**	0.72	**5.96**	2.72	**6.80**	2.01	**5.03**	0.97	**2.42**	41	0.72	**1.79**	56
	0.12	Herbivore (long grass)	1.66	**13.85**	1.23	**10.25**	0.54	**4.52**	0.40	**3.35**	1.66	**4.15**	1.23	**3.07**	0.54	**1.36**	74	0.40	1.00	-
	0.12	Herbivore (Broadleaf plants)	2.52	**20.98**	1.86	**15.53**	0.83	**6.94**	0.62	**5.13**	2.52	**6.29**	1.86	**4.66**	0.83	**2.08**	48	0.62	**1.54**	65

Bolded cells indicate RQ exceeds the LOC (level of concern)

Table 13 Refined mammalian risk assessment using maximum and mean abamectin residue values on the highest application rate on outdoor ornamentals (at 22.8 g a.i./ha × 10 days (foliar half-life) × 6 applications × 7 days interval) while considering 59% drift for early airblast application

			NOEL Values								LOEL Values									
			Maximum nomogram residues				Mean nomogram residues				Maximum nomogram residues				Mean nomogram residues					
			On-field		Off field		On-field		Off field		On-field		Off field		On-field			Off field		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
Small mammal (0.015 kg)																				
Acute	0.87	Insectivore	2.63	**3.02**	1.55	**1.78**	1.81	**2.08**	1.07	**1.23**	2.63	**3.02**	1.55	**1.78**	1.81	**2.08**	48	1.07	**1.23**	81
	0.87	Granivore (grain and seeds)	0.41	0.47	0.24	0.28	0.19	0.22	0.11	0.13	0.41	0.47	0.24	0.28	0.19	0.22	-	0.11	0.13	-
	0.87	Frugivore (fruit)	0.81	0.93	0.48	0.55	0.39	0.45	0.23	0.26	0.81	0.93	0.48	0.55	0.39	0.45	-	0.23	0.26	-
Reproduction	0.12	Insectivore	2.63	**21.88**	1.55	**12.91**	1.81	**15.11**	1.07	**8.91**	2.63	**6.56**	1.55	**3.87**	1.81	**4.53**	22	1.07	**2.67**	-
	0.12	Granivore (grain and seeds)	0.41	**3.39**	0.24	**2.00**	0.19	**1.62**	0.11	**0.95**	0.41	**1.02**	0.24	0.60	0.19	0.48	-	0.11	0.29	-
	0.12	Frugivore (fruit)	0.81	**6.77**	0.48	**4.00**	0.39	**3.23**	0.23	**1.91**	0.81	**2.03**	0.48	**1.20**	0.39	0.97	-	0.23	0.57	-
Medium sized mammal (0.035 kg)																				
Acute	0.87	Insectivore	2.30	**2.65**	1.36	**1.56**	1.59	**1.83**	0.94	**1.08**	2.30	**2.65**	1.36	**1.56**	1.59	**1.83**	55	0.94	**1.08**	93
	0.87	Granivore (grain and seeds)	0.36	0.41	0.21	0.24	0.17	0.20	0.10	0.12	0.36	0.41	0.21	0.24	0.17	0.20	-	0.10	0.12	-
	0.87	Frugivore (fruit)	0.71	0.82	0.42	0.48	0.34	0.39	0.20	0.23	0.71	0.82	0.42	0.48	0.34	0.39	-	0.20	0.23	-
	0.87	Herbivore (short grass)	5.09	**5.85**	3.00	**3.45**	1.81	**2.08**	1.07	**1.23**	5.09	**5.85**	3.00	**3.45**	1.81	**2.08**	48	1.07	**1.23**	81
	0.87	Herbivore (long grass)	3.11	**3.57**	1.83	**2.11**	1.02	**1.17**	0.60	0.69	3.11	**3.57**	1.83	**2.11**	1.02	**1.17**	86	0.60	0.69	-
	0.87	Herbivore (forage crops)	4.71	**5.42**	2.78	**3.20**	1.56	**1.79**	0.92	**1.06**	4.71	**5.42**	2.78	**3.20**	1.56	**1.79**	56	0.92	**1.06**	94
Reproduction	0.12	Insectivore	2.30	**19.18**	1.36	**11.32**	1.59	**13.25**	0.94	**7.81**	2.30	**5.75**	1.36	**3.40**	1.59	**3.97**	25	0.94	**2.34**	-
	0.12	Granivore (grain and seeds)	0.36	**2.97**	0.21	**1.75**	0.17	**1.42**	0.10	0.84	0.36	0.89	0.21	0.53	0.17	0.42	-	0.10	0.25	-
	0.12	Frugivore (fruit)	0.71	**5.94**	0.42	**3.50**	0.34	**2.83**	0.20	**1.67**	0.71	**1.78**	0.42	**1.05**	0.34	0.85	-	0.20	0.50	-
	0.12	Herbivore (short grass)	5.09	**42.44**	3.00	**25.04**	1.81	**15.07**	1.07	**8.89**	5.09	**12.73**	3.00	**7.51**	1.81	**4.52**	22	1.07	**2.67**	38
	0.12	Herbivore (long grass)	3.11	**25.91**	1.83	**15.29**	1.02	**8.46**	0.60	**4.99**	3.11	**7.77**	1.83	**4.59**	1.02	**2.54**	39	0.60	**1.50**	67
	0.12	Herbivore (Broadleaf plants)	4.71	**39.27**	2.78	**23.17**	1.56	**12.98**	0.92	**7.66**	4.71	**11.78**	2.78	**6.95**	1.56	**3.89**	26	0.92	**2.30**	44

			NOEL Values								LOEL Values									
			Maximum nomogram residues				Mean nomogram residues				Maximum nomogram residues				Mean nomogram residues					
			On-field		Off field		On-field		Off field		On-field		Off field		On-field			Off field		
	Toxicity (mg a.i./kg bw/d)	Food guild (food item)	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC	EDE (mg a.i./kg bw)	RQ	% diet to reach LOC
Large sized mammal (1 kg)																				
Acute	0.87	Insectivore	1.23	**1.41**	0.73	0.83	0.85	0.98	0.50	0.58	1.23	**1.41**	0.73	0.83	0.85	0.98	-	0.50	0.58	-
	0.87	Granivore (grain and seeds)	0.19	0.22	0.11	0.13	0.09	0.10	0.05	0.06	0.19	0.22	0.11	0.13	0.09	0.10	-	0.05	0.06	-
	0.87	Frugivore (fruit)	0.38	0.44	0.22	0.26	0.18	0.21	0.11	0.12	0.38	0.44	0.22	0.26	0.18	0.21	-	0.11	0.12	-
	0.87	Herbivore (short grass)	2.72	**3.13**	1.61	**1.85**	0.97	**1.11**	0.57	0.66	2.72	**3.13**	1.61	**1.85**	0.97	**1.11**	90	0.57	0.66	-
	0.87	Herbivore (long grass)	1.66	**1.91**	0.98	**1.13**	0.54	0.62	0.32	0.37	1.66	**1.91**	0.98	**1.13**	0.54	0.62	-	0.32	0.37	-
	0.87	Herbivore (Broadleaf plants)	2.52	**2.89**	1.49	**1.71**	0.83	0.96	0.49	0.56	2.52	**2.89**	1.49	**1.71**	0.83	0.96	-	0.49	0.56	-
Reproduction	0.12	Insectivore	1.23	**10.25**	0.73	**6.05**	0.85	**7.08**	0.50	**4.18**	1.23	**3.07**	0.73	**1.81**	0.85	**2.12**	47	0.50	**1.25**	80
	0.12	Granivore (grain and seeds)	0.19	**1.59**	0.11	0.94	0.09	0.76	0.05	0.45	0.19	0.48	0.11	0.28	0.09	0.23	-	0.05	0.13	-
	0.12	Frugivore (fruit)	0.38	**3.17**	0.22	**1.87**	0.18	**1.51**	0.11	0.89	0.38	0.95	0.22	0.56	0.18	0.45	-	0.11	0.27	-
	0.12	Herbivore (short grass)	2.72	**22.68**	1.61	**13.38**	0.97	**8.05**	0.57	**4.75**	2.72	**6.80**	1.61	**4.01**	0.97	**2.42**	41	0.57	**1.43**	70
	0.12	Herbivore (long grass)	1.66	**13.85**	0.98	**8.17**	0.54	**4.52**	0.32	**2.67**	1.66	**4.15**	0.98	**2.45**	0.54	**1.36**	74	0.32	0.80	-
	0.12	Herbivore (Broadleaf plants)	2.52	**20.98**	1.49	**12.38**	0.83	**6.94**	0.49	**4.09**	2.52	**6.29**	1.49	**3.71**	0.83	**2.08**	48	0.49	**1.23**	81

Bolded cells indicate RQ exceeds the LOC (level of concern)

Table 14 Screening level risk assessment of abamectin to aquatic organisms

Organism	Exposure	Test substance	Endpoint value	EEC (µg a.i./L)*	RQ	Level of concern exceeded?
Freshwater invertebrates						
SSD results for 14 freshwater invertebrates species: Most sensitive species: ***Daphnia pulex***	Acute	abamectin	HC_5: 0.025 µg a.i./L[1]	15	**600**	**Yes**
Cladocera *Daphnia magna*	21 d-Chronic semi-static	Abamectin 1.8% EC (1.8% a.i. w/v nominal;	NOEC =0.0082 ug a.i/L	15	**1829**	**Yes**

Organism	Exposure	Test substance	Endpoint value	EEC (µg a.i./L)*	RQ	Level of concern exceeded?
		1.695% w/v analysed)				
Freshwater fish (surrogate for aquatic-phase amphibians)						
Rainbow trout, *Oncorhynchus Mykiss*	96 hr Acute (semi-static)	Abamectin 1.8% EC (analysed purity 1.695% w/v)	LC_{50}/10 = 0.26 µg a.i./L	15	**58**	**Yes**
Rainbow trout, *Oncorhynchus Mykiss*	60 d Early life stage toxicity (flow-through)	Abamectin technical (91% w/w purity)	NOEC: 0.52 µg a.i./L	15	**29**	**Yes**
Amphibians						
African Clawed frog *(Xenopus laevis)*	Surrogate endpoint from rainbow trout	Abamectin 1.8% EC (analysed purity 1.695% w/v)	LC_{50}/10 = 0.26 µg a.i./L	80	**308**	**Yes**
	21 d metamorphosis assay (flow-through)	Abamectin Technical (98% w/w)	NOEC: 9.6 µg a.i./L	80	**8.3**	**Yes**
Freshwater algae						
Green alga *Desmodesmus subspicatus*	72 hr-Acute Static	Abamectin 1.8% EC	EbC_{50}/2: 259 µg a.i. /L	15	0.06	No
Diatom *Navicula pelliculosa*	96 hr-Acute Static	Abamectin technical	72 hr EyC_{50}/2 : 375 µg a.i./L	15	0.04	No
Estuarine/marine invertebrates						
Mysid shrimp *Mysidopsis bahia*	96 hr-Acute (flow-through)	^{3}H-avermectin B1a	EC_{50}/2: 0.011 µg a.i./L	15	**1500**	**Yes**
			LC_{50} /2: 0.012 µg a.i./L	15	**1304**	**Yes**
Mysid shrimp *Mysidopsis bahia*	28 d-Chronic (Flow- through)	^{3}H-avermectin B1a (96.3% purity)	**NOEC: 0.0022 µg a.i./L**	15	**6818**	**Yes**
Estuarine/marine fish						
Sheepshead minnows *Cyprinodon variegatus*	96 hr-Acute Static	Abamectin (91% w/w)	LC_{50} /2: **7.5 µg a.i./L** (nominal concentrations).	15	**2**	**Yes**
	34 d-early life stage Flow through	Abamectin Tech (98.0%)	NOEC: **0.34 µg a.i./L** (larval survival)	15	**44**	**Yes**
Estuarine/marine alga						
Marine Diatom *Skeletonema costatum*	72 hr-Acute Static	Abamectin 98% purity	EbC_{50} /2: 55 µg a.i./L	15	0.3	No

Bolded cells indicate RQ exceeds the LOC (level of concern)

*maximum single application rate due to higher water renewal rates in tidal/estuarine areas.

Screening level EEC based on direct application to water at 120.278 g a.i./ha (22.8 g a.i./ha × 6 × (half-life of 91.3 days) × 7 days interval). 80 cm EEC = 15 µg a.i./L; 15 cm EEC = 80 µg a.i./L

Table 15 Refined risk assessment of abamectin for aquatic organisms from drift

Organism	Exposure	Endpoint value (µg a.i./L)	Refined EEC* (µg a.i./L)		RQ	Level of Concern
Freshwater species						
SSD for 14 freshwater invertebrates species: Most sensitive species: ***Daphnia pulex***	Acute	HC_5: 0.025[a]	Ground appl.: 1.7		**66**	**Yes**
			Airblast appl.	E. season: 11.1	**444**	
				L. season: 8.85	**354**	
Cladocera *Daphnia magna*	Chronic	NOEC = 0.0082	Ground appl.: 1.7		**201**	
			Airblast appl.	E. season: 11.1	**1354**	
				L. season: 8.85	**1079**	
Rainbow trout, *Oncorhynchus Mykiss*	Acute	LC_{50}/10**:** 0.26	Ground appl.: 1.7		**6.3**	
			Airblast appl.	E. season: 11.1	**43**	
				L. season: 8.85	**34**	
	Chronic	NOEC: 0.52	Ground appl.: 1.7		**3.2**	**Yes**
			Airblast appl.	E. season: 11.1	**21**	
				L. season: 8.85	**17**	
				L. season: 8.85	**1.5**	
African Clawed frog *(Xenopus laevis)*	Acute (*Oncorhynchus Mykiss*)	LC_{50}/10 = 0.26	Ground appl.: 8.8		**34**	
			Airblast appl.	E. season:59.2	**228**	**Yes**
				L. season: 47.2	**182**	
	Chronic metamorphosis assay	NOEC = 9.6	Ground appl.: 8.8		0.9	No
			Airblast appl.	E. season: 59.2	**6.2**	**Yes**
				L. season: 47.2	**4.9**	
Marine species (using single maximum application rate and acute endpoints only)						
Crustacean Mysid shrimp *Mysidopsis bahia*	Acute	LC_{50}/2 = 0.011	Ground appl.: 0.4		**39**	
			Airblast appl	E. season: 2.6	**265**	**Yes**
				L. season: 2.1	**211**	
Fish Sheepshead minnows *Cyprinodon variegatus*	Acute	LC_{50}/10 = 1.5	Ground appl.: 0.4		0.1	No
			Airblast appl	E. season: 2.6	1.8	**Yes**
				L. season: 2.1	1.4	**Yes**
Marine Diatom *Skeletonema costatum*	Acute	EC_{50}/2= 55	Ground appl.: 0.4		0.007	
			Airblast appl	E. season: 2.6	0.05	No
				L. season: 2.1	0.04	

Bolded cells indicate RQ exceeds the LOC (level of concern)

*Drift depositions: 11% (ground application), 74% (air blast application early season) and 59% (air blast application late season) based on EEC of 0.015 and 0.08 mg/L for 80 and 15 cm depth, respectively.

[a] SSD results for 14 freshwater invertebrates species: (Daphnia pulex, Simocephalus sp., Daphnia magna, Daphnia longispina Diaphanosoma sp., Daphnia galeata, Eudiaptomus graciloides Cloeon sp., Fairy shrimp (Eudiaptomus graciloides), Gammarus sp., Lymnaea stagnalis, Ostracoda, Charoborus sp. Brachiomus calyciflorus)

Table 16 Refined risk assessment of abamectin for aquatic organisms from predicted run-off

Organism	Exposure and Endpoint Value ((µg a.i./L)	Use rate	Mitigation	Runoff (µg a.i./L)*	RQ	Level of concern exceeded?
Freshwater organisms						
SSD for 14 freshwater invertebrates species: Most sensitive species: *Daphnia pulex*	48 hr Acute HC_5: 0.025[a]	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		1.5	**60**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		1.0	**40**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d	Reduced Rate	0.48	**19.2**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d	Reduced Rate and 10 m VFS	0.32	**12.8**	**Yes**
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.034	**1.4**	**Yes**
Cladocera *Daphnia magna*	21 d Chronic NOEC = 0.0082	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		0.62	**76**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.43	**52**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d	Reduced Rate	0.17	**20.7**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d with 10 m VFS	Reduced Rate and 10 m VFS	0.09	**11**	**Yes**
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.01	**1.3**	**Yes**
Rainbow trout, *Oncorhynchus Mykiss*	96 hr Acute $LC_{50}/2$ = 0.26	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		1.1	**4.2**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.73	**2.8**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d	Reduced Rate	0.48	**1.8**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d with 10 m VFS	Reduced Rate and 10 m VFS	0.32	**1.2**	**Yes**
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.023	0.09	No

Organism	Exposure and Endpoint Value ((µg a.i./L)	Use rate	Mitigation	Runoff (µg a.i./L)*	RQ	Level of concern exceeded?
Rainbow trout, *Oncorhynchus Mykiss*	60 d Early Life Stage NOEC: 0.52	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		0.62	**1.2**	**Yes**
Amphibians	Acute (rainbow trout as surrogate) LC_{50}/10 = 0.26	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		1.3	**5**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.94	**3.6**	**Yes**
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.03	0.12	No
	Metamorphosis assay as chronic NOEC = 9.6	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		0.69	0.1	No
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.49	0.1	No
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.012	0.001	No
Marine organisms [b]						
Crustacean Mysid shrimp *Mysidopsis bahia* Mysid shrimp *Mysidopsis bahia*	96 hr Acute LC_{50}/2 = 0.011	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		1.1	**100**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.73	**66**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d	Reduced Rate	0.48	**43.6**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d with 10 m VFS	Reduced Rate and 10 m VFS	0.32	**29.1**	**Yes**
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.023	**2.1**	**Yes**
	28d-Chronic (Flow- through) NOEC: 0.0022	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		0.62	**282**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.43	**196**	**Yes**
		Raspberry/ 2 ×	Reduced Rate	0.17	**77**	**Yes**

Organism	Exposure and Endpoint Value ((µg a.i./L)	Use rate	Mitigation	Runoff (µg a.i./L)*	RQ	Level of concern exceeded?
		19 g a.i./ha @ 7 d				
		Raspberry/ 2 × 19 g a.i./ha @ 7 d with 10 m VFS	Reduced Rate and 10 m VFS	0.09	**4**	**Yes**
		Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.01	**5**	**Yes**
Fish Sheepshead minnows *Cyprinodon variegatus*	Acute LC_{50}/10=1.5	Pear/ 1 × 28.6 g a.i./ha @ 7 d		0.023	0.02	No
	34d- early life stage Flow through NOEC: 0.34 (larval survival)	Ornamentals/ 6 × 22.8 g a.i./ha @ 7 d		0.62	**1.8**	**Yes**
		Raspberry/ 5 × 19 g a.i./ha @ 7 d		0.43	**1.3**	**Yes**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d	Reduced Rate	0.17	**0.5**	**No**
		Raspberry/ 2 × 19 g a.i./ha @ 7 d with 10 m VFS	Reduced Rate and 10 m VFS	0.09	**0.3**	**No**

Bolded cells indicate RQ exceeds the LOC (level of concern)
*EECs representing the 90th percentile of 24 or 96-hour concentration (acute assessment) and 21-day concentration (chronic assessment) as predicted by PWC.
[a] SSD results for 14 freshwater invertebrates species: (Daphnia pulex, Simocephalus sp., Daphnia magna, Daphnia longispina, Diaphanosoma sp., Daphnia galeata, Eudiaptomus graciloides Cloeon sp., Fairy shrimp (Eudiaptomus graciloides), Gammarus sp., Lymnaea stagnalis, Ostracoda, Charoborus sp. Brachiomus calyciflorus).
[b] For the marine organisms risk assessment, estimated concentrations are not expected to persist due to mixing and tides.

Table 17 Toxic substances management policy considerations - Comparison to TSMP Track 1 criteria

TSMP Track 1 Criteria	TSMP Track 1 Criterion value		Abamectin are criteria met?	Transformation products, criteria met?
CEPA toxic or CEPA toxic equivalent[1]	Yes		Yes	Yes
Predominantly anthropogenic[2]	Yes		Yes	Yes
Persistence[3]:	Soil	Half-life ≥ 182 days	No. Laboratory studies: DT_{50} of 16.4 to 49.2 days in aerobic soil and 80 days in anaerobic soil. Field studies: DT_{50} of 2.5 – 12 hrs.	No Laboratory studies: DT_{50} of 26.8 to 173 days in aerobic soil as determined by EFSA. No endpoints were available for anaerobic exposure.
	Water	Half-life ≥ 182 days	No. Water phase: DT_{50} of 0.8 – 1.3 days.	No aquatic degradation information is available for major transformation products of abamectin
	Whole system (Water + Sediment)	Half-life ≥ 365 days	No. Total system DT_{50} values range from 86.9 to 91.3 days in aerobic and 229.6 to 311.6 days in anaerobic water-sediment systems.	
	Air	Half-life ≥ 2 days or evidence of long range transport	Not determined. The AOPWIN model is not suitable~~ed~~ for predicting the atmospheric half-life of abamectin given the large fraction expected to be sorbed to airborne particles.	No air degradation information was available for major transformation products of abamectin
Bioaccumulation[4]	Log K_{ow} ≥ 5		No: 4.4	No information was available on the bioaccumulation of the major transformation products of abamectin.
	BCF ≥ 5000		No: 69	
	BAF ≥ 5000		Not available	
Is the chemical a TSMP Track 1 substance (all four criteria must be met)?			**No, does not meet all TSMP Track 1 criteria.**	**No**

[1] All pesticides will be considered CEPA-toxic or CEPA toxic equivalent for the purpose of initially assessing a pesticide against the TSMP criteria. Assessment of the CEPA toxicity criteria may be refined if required (in other words, all other TSMP criteria are met).
[2] The policy considers a substance "predominantly anthropogenic" if, based on expert judgment, its concentration in the in any environment medium is due largely to the quantities of the substance used or released as a result of human activity relative to contributions from natural sources.
[3] The pesticide and/or the transformation product(s) is considered persistent when the criterion is met in any one medium.
[4] Bioaccumulation Factors (BAF) are preferred over Bioconcentration Factors (BCF); in the absence of BAF or BCF data, the octanol-water partition coefficient (log K_{ow}) may be used.

Appendix X Proposed label amendment for products containing abamectin

Information on labels of currently registered products should not be removed unless it contradicts the following label statements.

1.0 Label amendments for Abamectin technical products

The following statements are to be added to the "Environmental Precautions" section of abamectin Technical Insecticide label:

> Toxic to aquatic organisms.
>
> DO NOT discharge effluent containing this product into sewer systems, lakes, streams, ponds, estuaries, oceans or other waters.

The following statements are required under the "Disposal" Section of the Abamectin Technical label:

> Canadian manufacturers should dispose of unwanted active ingredients and containers in accordance with municipal or provincial regulations. For additional details and cleanup of spills, contact the manufacturer and the provincial regulatory agency.

2.0 Label amendments for Abamectin commercial end-use products

The following statement is required under the "Directions for Use" Section:

- **DO NOT** exceed a maximum cumulative application rate of 38 g a.i./ha/per year.

2.1 General Label Improvements

The following label statements are proposed to be added to the PRECAUTIONS of all commercial end-use product labels, unless already present:

- "Apply only when the potential for drift to areas of human habitation or areas of human activity such as houses, cottages, schools, and recreational areas is minimal. Take into consideration wind speed, wind direction, temperature inversions, application equipment and sprayer settings"

The following label statements are proposed to be added to all commercial class structural and domestic class end-use product labels, unless already present:

- "Keep out of the reach of children and domestic animals."

2.2 Label Amendments for Avid 1.9% EC Miticide/Insecticide (PCP 24485)

The following statements are to be added under PRECAUTIONS:

2.2a) **Replace:** "Wear coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, socks, chemical-resistant footwear and headgear during mixing, loading, application, clean-up, and repair. Mixer/loaders and applicators must wear either a respirator with a NIOSH approved organic-vapour-removing cartridge with a prefilter approved for pesticides OR a NIOSH-approved canister approved for pesticides."

With: "Wear coveralls over a long-sleeved shirt, long pants, chemical-resistant gloves, socks, chemical-resistant footwear, and a respirator with a NIOSH-approved organic-vapour-removing cartridge with a prefilter approved for pesticides, or a NIOSH-approved canister approved for pesticides during mixing, loading, application, clean-up and repair.

2.2b) **Add:** "For application using handheld airblast/mistblower equipment, wear chemical-resistant coveralls with a chemical-resistant hood over long-sleeved shirt, long pants, chemical-resistant gloves, socks, chemical-resistant footwear and a respirator with a NIOSH-approved organic-vapour-removing cartridge with a prefilter approved for pesticides OR a NOSH-approved canister approved for pesticides."

2.2c) **Add:** "**DO NOT** use on ornamentals grown for cut flowers in greenhouses."

2.2d) **The following statements are to be added to the "Environmental Precautions" section:**

Toxic to aquatic organisms. Observe spray buffer zones specified under DIRECTIONS FOR USE.

Toxic to birds and small mammals.

Toxic to bees. Bees may be exposed through direct spray, spray drift, and residues on/in leaves, pollen and nectar in flowering crops and weeds. Minimize spray drift to reduce harmful effects on bees in habitats close to the application site. Avoid applications when bees are foraging in the treatment area in ground cover containing blooming weeds. To further minimize exposure to pollinators, refer to the complete guidance "Protecting Pollinators during Pesticide Spraying – Best Management Practices" on the Health Canada website (www.healthcanada.gc.ca/pollinators). Follow crop specific directions for application timing.

For applications on crops that are highly attractive to pollinators [outdoor ornamentals, excluding coniferous evergreens (pine, fir, juniper, spruce, arborvitae, hemlock, cypress, yew) and ornamental grasses] or when using managed bees for pollination services:

DO NOT apply during the crop blooming period (onset of flowering until after petal fall is complete).

Toxic to certain beneficial arthropods (which may include predatory and parasitic insects, spiders, and mites). Minimize spray drift to reduce harmful effects on beneficial arthropods in habitats next to the application site such as hedgerows and woodland.

For greenhouse only: Toxic to bees and other beneficial arthropods (which may include predatory and parasitic insects, spiders, and mites). May harm bees and other beneficial arthropods, including those used in greenhouse production. Avoid application when bees or other beneficial arthropods are in the treatment area.

To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil, or clay.

Avoid application of this product when heavy rain is forecast.

To reduce risk to aquatic organisms from runoff, a vegetative filter strip of at least 10 metres wide between the field edge and adjacent, downhill aquatic habitats must be observed, as specified under DIRECTIONS FOR USE.

2.2e) The following statements are required under the "Directions for Use" Section:

To protect pollinators, follow the instructions regarding bees in the Environmental Precautions section.

For outdoor ornamentals only: Toxic to bees. **DO NOT** apply during the crop blooming period (onset of flowering until after petal fall is complete). (Excludes ornamental grasses and coniferous evergreens: pine, fir, juniper, spruce, arborvitae, hemlock, cypress, yew).

For boxwood only: Toxic to bees. **DO NOT** apply during the crop blooming period (onset of flowering until after petal fall is complete).

For greenhouse only: Toxic to bees and other beneficial arthropods (which may include predatory and parasitic insects, spiders, and mites). May harm bees and other beneficial arthropods, including those used in greenhouse production. Avoid application when bees or other beneficial arthropods are in the treatment area.

As this product is not registered for the control of pests in aquatic systems, **DO NOT** use to control aquatic pests.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

A Vegetative Filter Strip (VFS) of at least 10 metres wide must be constructed and maintained. The VFS is required between the field edge and adjacent, downhill aquatic habitats to reduce risk to aquatic organisms from run-off. Aquatic habitats include, but are not limited to, lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, and estuaries.

The VFS is to be composed of grasses and may also include shrubs, trees, or other vegetation. Additional guidance can be found on the PMRA Environmental Risk Mitigation webpages.

Both VFS and spray drift buffer zones must be observed.

For greenhouse use: **DO NOT** allow releases, effluent or runoff from greenhouses containing this product to enter lakes, streams, ponds or other waters.

Field sprayer application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE S572.1) fine classification. Boom height must be 60 cm or less above the crop or ground.

Airblast application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. **DO NOT** apply when wind speed is greater than 16 km/h at the application site as measured outside of the treatment area on the upwind side.

DO NOT apply by air.

The spray buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Spray buffer zone table for end-use products - Avid 1.9% EC (PCP 24485)

Method of application	Crop		Spray buffer zones (metres) required for the protection of:			
			Freshwater habitat of depths:		Estuarine/Marine habitat of depths:	
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m
Field sprayer	Outdoor ornamentals (non-specific), boxwood		40	20	15	10
Airblast	Outdoor ornamentals	Early growth stage	50	40	35	25
		Late growth stage	40	30	25	20

When tank mixes are permitted, consult the labels of the tank-mix partners and observe the largest (most restrictive) spray buffer zone of the products involved in the tank mixture and apply using the coarsest spray (ASAE) category indicated on the labels for those tank mix partners.

The spray buffer zones for this product can be modified based on weather conditions and spray equipment configuration by accessing the Spray Buffer Zone Calculator on the Pesticides portion of the Canada.ca website.

2.3 Label Amendments for Agri-Mek 1.9% EC Miticide/Insecticide (PCP 24551) and Agri-Mek 1.9% SC Miticide/Insecticide (PCP 31607)

The following statements are to be added under PRECAUTIONS:

2.3a) **Replace:** "Wear coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, socks, chemical-resistant footwear and headgear during mixing, loading, application, clean-up and repair. Mixer/loaders and applicators must wear either a respirator with a NIOSH approved organic-vapour-removing cartridge with a prefilter approved for pesticides OR a NIOSH-approved canister approved for pesticides."

With: "Wear coveralls over a long-sleeved shirt, long pants, chemical-resistant gloves, socks, chemical-resistant footwear and a respirator with a NIOSH-approved organic-vapour-removing cartridge with a prefilter approved for pesticides, or a NIOSH-approved canister approved for pesticides during mixing, loading, application, clean-up and repair. In addition, wear chemical-resistant headgear during open-cab airblast application. Chemical-resistant headgear includes Sou'Wester hat, chemical-resistant rain hat or large-brimmed waterproof hat and hood with sufficient neck protection. Gloves are not required during application within a closed cab"

2.3b) **Add:** "For application using handheld airblast/mistblower equipment, wear chemical-resistant coveralls with a chemical-resistant hood over long-sleeved shirt, long pants, chemical-resistant gloves, socks, chemical-resistant footwear and a respirator with a NIOSH-approved organic-vapour-removing cartridge with a prefilter approved for pesticides OR a NOSH-approved canister approved for pesticides."

2.3c) **Add:** "For application using handheld airblast/mistblower, DO NOT handle more than [7.5 g a.i. to be reported in product equivalent value] per person per day."

2.3d) **Add:** "For handheld application, wear eye, head and respiratory protection when applying above waist height, including overhead."

2.3e) **Replace:** "**DO NOT** enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 12 hours."

OR

"Do not enter area until sprays have dried."

With the following, where appropriate: "**DO NOT** enter or allow entry into treated areas during the intervals specified in the following table:

Crop	Postapplication activity	REI and/or PHI (days)[d]
Apple	Harvesting	28
	All other activities	12 hours
Bulb onion	Harvesting	30

Crop	Postapplication activity	REI and/or PHI (days)[d]
sub-group Crop group 3-07A	Hand weeding	1
	All other activities	12 hours
Caneberries Subgroup 13-07A	Harvesting	7 days
	All activities	12 hours
Celery	Harvesting	14
	All other activities	12 hours
Grapes	Harvesting	28
	Girdling, turning	11
	Leaf pulling (by hand), tying/training	3
	All other activities	12 hours
Green onion Subgroup 3-07B	Harvesting	7
	Hand weeding	2
	All other activities	12 hours
Greenhouse cucumbers/peppers	Harvesting	3 days
	All other activities	12 hours
Greenhouse tomatoes	Harvesting	1 days
	All other activities	12 hours
Hops	Harvesting	28
	Mechanically assisted harvesting	10
	All other activities	12 hours
Pears	Harvesting	28
	All other activities	12 hours
Potatoes	Harvesting	14
	All other activities	12 hours
Strawberries	Harvesting	3[a]
	All other activities	12 hours

REI = Restricted-entry interval; PHI = pre-harvest interval; RTI = retreatment interval
[a]Pre-harvest application of ABM, PHI = 3 days. Post-harvest application of ABM, PHI = 10 months.

2.3f) The following statements are to be added to the "Environmental Precautions"

Toxic to aquatic organisms and terrestrial plants. Observe spray buffer zones specified under DIRECTIONS FOR USE.

Toxic to birds and small mammals.

Toxic to bees. Bees may be exposed through direct spray, spray drift, and residues on/in leaves, pollen and nectar in flowering crops and weeds. Minimize spray drift to reduce harmful effects on bees in habitats close to the application site. Avoid applications when bees are foraging in the treatment area in ground cover containing blooming weeds. To further minimize exposure to pollinators, refer to the complete guidance "Protecting Pollinators during Pesticide Spraying – Best Management Practices" on the Health Canada website (www.canada.ca/pollinators). Follow crop specific directions for application timing.

For applications on crops that are highly attractive to pollinators (apple, pear, cranberry) or when using managed bees for pollination services: Do not apply during the crop blooming period (onset of flowering until after petal fall is complete).

For applications on strawberry, potato, grape: Avoid application during the crop blooming period. If applications must be made during the crop blooming period, restrict applications to evening when most bees are not foraging.

Toxic to certain beneficial arthropods (which may include predatory and parasitic insects, spiders, and mites). Minimize spray drift to reduce harmful effects on beneficial arthropods in habitats next to the application site such as hedgerows and woodland.

To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil, or clay.

Avoid application of this product when heavy rain is forecast.

To reduce risk to aquatic organisms from runoff, a vegetative filter strip of at least 10 metres wide between the field edge and adjacent, downhill aquatic habitats must be observed, as specified under DIRECTIONS FOR USE.

2.3g) The following statements are required under the "Directions for Use" section:

To protect pollinators, follow the instructions regarding bees in the Environmental Precautions section.

As this product is not registered for the control of pests in aquatic systems, **DO NOT** use to control aquatic pests.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

A Vegetative Filter Strip (VFS) of at least 10 metres wide must be constructed and maintained. The VFS is required between the field edge and adjacent, downhill aquatic habitats to reduce risk to aquatic organisms from run-off. Aquatic habitats include, but are not limited to, lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, and estuaries.

The VFS is to be composed of grasses and may also include shrubs, trees, or other vegetation. Additional guidance can be found on the PMRA Environmental Risk Mitigation webpages.

Both VFS and spray drift buffer zones must be observed.

Field sprayer application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE S572.1) fine classification. Boom height must be 60 cm or less above the crop or ground.

Airblast application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. **DO NOT** apply when wind speed is greater than 16 km/h at the application site as measured outside of the treatment area on the upwind side.

DO NOT apply by air.

The spray buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Spray buffer zone table for end-use products Agri-Mek 1.9% EC (PCP 24551) and Agi-Mek SC (PCP 31607)

Method of application	Crop		Spray buffer zones (metres) required for the protection of:			
			Freshwater habitat of depths:		Estuarine/Marine habitat of depths:	
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m
Field sprayer	Caneberries (crop group 13-07A, potatoes, strawberries		45	25	25	10
	Celery, bulb onion sub-group) Crop group 3-07A, Green onion Subgroup 3-07B		40	20	15	10
Airblast	Grapes	Early growth stage	45	35	45	35
	Hops		45	35	35	25
	Pears		50	40	45	35
	Apples		40	30	40	30
	Grapes	Late growth stage	35	25	35	25
	Hops		35	25	25	15
	Pears		40	30	35	25
	Apples		30	25	30	20

When tank mixes are permitted, consult the labels of the tank-mix partners and observe the largest (most restrictive) spray buffer zone of the products involved in the tank mixture and apply using the coarsest spray (ASAE) category indicated on the labels for those tank mix partners.
The spray buffer zones for this product can be modified based on weather conditions and spray equipment configuration by accessing the Spray Buffer Zone Calculator on the Pesticides portion of the Canada.ca website.

2.4 Label Amendments for Minecto Pro (co-formulation of cyantraniliprole and abamectin) (PCP 33023)

The following statements are to be added under PRECAUTIONS:

2.4a) **Replace:** "Wear coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, socks, chemical-resistant footwear and headgear during mixing, loading, application, clean-up and repair. Mixer/loaders and applicators must wear either a respirator with a NIOSH approved organic-vapour-removing cartridge with a prefilter approved for pesticides OR a NIOSH-approved canister approved for pesticides."

With: "Wear coveralls over a long-sleeved shirt, long pants, chemical-resistant gloves, socks, chemical-resistant footwear and a respirator with a NIOSH-approved organic-vapour-removing cartridge with a prefilter approved for pesticides, or a NIOSH-approved canister approved for pesticides during mixing, loading, application, clean-up and repair. In addition, wear chemical-resistant headgear during open-cab airblast application. Chemical-resistant headgear includes Sou'Wester hat, chemical-resistant rain hat or large-brimmed waterproof hat and hood with sufficient neck protection. Gloves are not required during application within a closed cab"

2.4b) **Add:** "For application using handheld airblast/mistblower equipment, wear chemical-resistant coveralls with a chemical-resistant hood over long-sleeved shirt, long pants, chemical-resistant gloves, socks, chemical-resistant footwear and a respirator with a NIOSH-approved organic-vapour-removing cartridge with a prefilter approved for pesticides OR a NOSH-approved canister approved for pesticides."

2.4c) **Add:** "For application using handheld airblast/mistblower, DO NOT handle more than [7.5 g a.i. to be reported in product equivalent value] per person per day."

2.4d) **Add:** "For handheld application, wear eye, head and respiratory protection when applying above waist height, including overhead."

2.4e) **Replace:** "**DO NOT** enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 12 hours."

OR

"Do not enter area until sprays have dried."

With the following, where appropriate: "**DO NOT** enter or allow entry into treated areas during the intervals specified in the following table:

Crop	Postapplication activity	REI and/or PHI (days)[d]
Apple	Harvesting	28
	All other activities	12 hours
Bulb onion sub-group	Harvesting	30
	Hand weeding	1

Crop	Postapplication activity	REI and/or PHI (days)[d]
Crop group 3-07A	All other activities	12 hours
Caneberries Subgroup 13-07A	Harvesting	7 days
	All activities	12 hours
Celery	Harvesting	14
	All other activities	12 hours
Grapes	Harvesting	28
	Girdling, turning	11
	Leaf pulling (by hand), tying/training	3
	All other activities	12 hours
Green onion Subgroup 3-07B	Harvesting	7
	Hand weeding	2
	All other activities	12 hours
Greenhouse cucumbers/peppers	Harvesting	3 days
	All other activities	12 hours
Greenhouse tomatoes	Harvesting	1 days
	All other activities	12 hours
Hops	Harvesting	28
	Mechanically assisted harvesting	10
	All other activities	12 hours
Pears	Harvesting	28
	All other activities	12 hours
Potatoes	Harvesting	14
	All other activities	12 hours
Strawberries	Harvesting	3[a]
	All other activities	12 hours

PHI= pre-harvest interval; RTI= retreatment interval, REI = Restricted-entry interval
[a]Pre-harvest application of ABM, PHI = 3 days. Post-harvest application of ABM, PHI = 10 months.

2.4f) The following statements are to be added to the "Environmental Precautions" section:

Toxic to aquatic organisms and terrestrial plants. Observe spray buffer zones specified under DIRECTIONS FOR USE.

Toxic to birds and small mammals.

Toxic to bees. Bees may be exposed through direct spray, spray drift, and residues on/in leaves, pollen and nectar in flowering crops and weeds. Cyantraniliprole is systemic and bees can be exposed to product residues in flower, leaves, pollen and/or nectar resulting from soil applications. Minimize spray drift to reduce harmful effects on bees in habitats close to the application site. Avoid applications when bees are foraging in the treatment area in ground cover containing blooming weeds. To further minimize exposure to pollinators, refer to the complete guidance "Protecting Pollinators during Pesticide Spraying – Best Management Practices" on the Health Canada website (www.canada.ca/pollinators). Follow crop specific directions for application timing.

For applications on crops that are highly attractive to pollinators (apple and pear) or when using managed bees for pollination services: Do not apply during the crop blooming period (onset of flowering until after petal fall is complete).

For applications on cucurbit vegetables, fruiting vegetables, potato and sweet potato: Avoid application during the crop blooming period. If applications must be made during the crop blooming period, restrict applications to evening when most bees are not foraging.

Toxic to certain beneficial arthropods (which may include predatory and parasitic insects, spiders, and mites). Minimize spray drift to reduce harmful effects on beneficial arthropods in habitats next to the application site such as hedgerows and woodland.

To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil, or clay.

Avoid application of this product when heavy rain is forecast.

To reduce risk to aquatic organisms from runoff, a vegetative filter strip of at least 10 metres wide between the field edge and adjacent, downhill aquatic habitats must be observed, as specified under DIRECTIONS FOR USE.

2.4g) The following statements are required under the "Directions for Use" Section:

To protect pollinators, follow the instructions regarding bees in the Environmental Precautions section.

For apple and pear only: Toxic to bees. Do not apply during the crop blooming period (onset of flowering until after petal fall is complete).

For cucurbit vegetables, fruiting vegetables and tuberous and corm vegetables (including potato and sweet potato) only: Toxic to bees. Avoid application during the crop blooming period. If applications must be made during the crop blooming period, restrict applications to evening when most bees are not foraging. When using managed bees for pollination services, **DO NOT** apply during the crop blooming period (onset of flowering until after petal fall is complete).

As this product is not registered for the control of pests in aquatic systems, **DO NOT** use to control aquatic pests.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

A Vegetative Filter Strip (VFS) of at least 10 metres wide must be constructed and maintained. The VFS is required between the field edge and adjacent, downhill aquatic habitats to reduce risk to aquatic organisms from run-off. Aquatic habitats include, but are not limited to, lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, and estuaries.

The VFS is to be composed of grasses and may also include shrubs, trees, or other vegetation. Additional guidance can be found on the PMRA Environmental Risk Mitigation webpages.

Both VFS and spray drift buffer zones must be observed.

Field sprayer application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE S572.1) fine classification. Boom height must be 60 cm or less above the crop or ground.

Airblast application: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. **DO NOT** apply when wind speed is greater than 16 km/h at the application site as measured outside of the treatment area on the upwind side.

DO NOT apply by air.

The spray buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Spray buffer zone table for abamectin content in Minecto Pro (co-formulation of abamectin and cyantraniliprole (PCP 33023)

Method of application	Crop		Spray buffer zones (metres) required for the protection of:			
			Freshwater habitat of depths:		Estuarine/Marine habitat of depths:	
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m
Field sprayer	Cucurbit vegetables (crop Group 9), Leafy Greens (Crop subgroup 4-13A), Potatoes, Tuberous and Corm Vegetables (Crop subgroup 1C), celeriac		45	25	25	10
	Fruiting vegetables, Leaf petioles (crop group 22-B)		40	20	15	10
Airblast	Pears	Early growth stage	50	40	45	35
	Apples		40	30	40	30
	Pears	Late growth stage	40	30	35	25
	Apples		30	25	30	20

*Note for PRVD: These spray buffer zones are for abamectin only. Care must be taken to ensure the correct spray buffer zones

appear on the product label after the final decision. This product is co-formulated with another active ingredient that results in larger spray buffer zones. Until the re-evaluation of this co-formulant is completed, ensure that the correct spray buffer zones for this product are presented on the product label.

When tank mixes are permitted, consult the labels of the tank-mix partners and observe the largest (most restrictive) spray buffer zone of the products involved in the tank mixture and apply using the coarsest spray (ASAE) category indicated on the labels for those tank mix partners.

The spray buffer zones for this product can be modified based on weather conditions and spray equipment configuration by accessing the Spray Buffer Zone Calculator on the Pest Management Regulatory Agency web site.

2.5 Label Amendments for Prescription Treatment Brand AVERT PLUS Canadian Carpenter Ant Bait (27863) / Prescription Treatment Brand AVERT PLUS Granular Carpenter Ant Bait (27864)

The following statements are to be added under PRECAUTIONS:

2.5a) **Replace:** "Wear a long-sleeved shirt, long pants, and chemical-resistant gloves during mixing, loading, and application."

With: "Wear a long-sleeved shirt, long pants, chemical-resistant gloves, socks and shoes during mixing, loading, application, clean-up and repair."

References

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