Pest Management Regulatory Agency
Agence de réglementation de la lutte antiparasitaire

Proposed Acceptability for Continuing Registration

PACR2005-02

Re-evaluation of Phosalone

The purpose of this document is to inform registrants, pesticide regulatory officials and the Canadian public that Health Canada's Pest Management Regulatory Agency (PMRA) has re-evaluated phosalone. Based on information available to the PMRA and consistent with the approach of the United States Environmental Protection Agency (USEPA), it is proposed that uses of phosalone on apple, cherry, grape, peach, pear, plum and prune plum crops be phased out in light of the identified worker and residential postapplication risks unless further data are provided to demonstrate acceptable risk. The PMRA is willing to consult with stakeholders on transition issues related to pest control product needs.

This Proposed Acceptability for Continuing Registration (PACR) document provides a summary of the data and information reviewed as well as the rationale for the proposed regulatory decision for phosalone. By way of this document, the PMRA is soliciting comments from interested parties on the proposed regulatory decision for phosalone. The PMRA will accept written comments on this proposal up to 60 days from the date of publication of this document to allow interested parties an opportunity to provide input into the proposed decision. Please forward all comments to Publications at the address below.

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Foreword

The available information on the active ingredient phosalone and its label uses on apple, cherry, grape, peach, pear, plum and prune plum has been re-evaluated by Health Canada's Pest Management Regulatory Agency (PMRA). The registrant of the technical grade active ingredient is Cheminova Canada.

The PMRA announced in June 1999 that products containing organophosphate (OP) active ingredients, including phosalone, were subject to re-evaluation under authority of Section 19 of the Pest Control Products Regulations.[1]

The PMRA has carried out an assessment of available information and has found it sufficient to allow a determination of the safety, merit and value of phosalone and its uses. Based on the information available to the PMRA, it is concluded that the occupational and residential postapplication exposure risks from the use of phosalone and its end-use products are of concern. Furthermore, based on information available to the PMRA, there is little reported use of products containing phosalone in Canada. It is therefore proposed that phosalone use be phased out of the Canadian market unless further data are provided, including demonstrating acceptable postapplication risk. It is also recommended that the Food and Drug Regulations Division 15, Table II, be amended to remove all phosalone maximum residue limits, as described in the document.

[1] Re-evaluation Document REV99-01, *Re-evaluation of Organophosphate Pesticides*.

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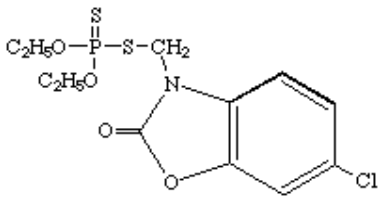
1.0 Purpose

This document describes the outcome of the PMRA re-evaluation of available data and information on the insecticide phosalone and its end-uses. It includes assessments of human health and environment as well as information on the value of phosalone to pest management in Canada. By way of this document, the PMRA is soliciting comments from interested parties on the proposed decision for phosalone.

2.0 Re-evaluation of Phosalone

Phosalone is one of the 27 OP pesticides subject to re-evaluation in Canada. The re-evaluation of phosalone was announced in Re-evaluation Document REV99-01, *Re-evaluation of Organophosphate Pesticides*. Phosalone is a broad-spectrum OP insecticide that inhibits the enzyme acetylcholinesterase, interrupting the transmission of nerve impulses. It controls pests that contact or ingest sufficient phosalone residues.

2.1 Chemical Identification

Active substance:	Phosalone
Function:	Insecticide
Chemical Name IUPAC:	S-6-chloro-2,3-dihydro-2-oxobenzoxazol-3-ylmethyl O,O-diethyl phosphorodithioate
CAS:	S-[(6-chloro-2-oxo-3(2H)-benzoxazolyl)methyl] O,O-diethyl phosphorodithioate
Chemical family:	Organophosphate
CAS number:	2310-17-0
Molecular formula:	$C_{12}H_{15}ClNO_4PS_2$
Molecular weight:	368
Structural formula:	
Basic manufacturer:	Voltas Limited, India

2.1.1 Identity of Relevant Impurities of Toxicological, Environmental and/or Other Significance

The technical grade active ingredient was analyzed for two impurities of toxicological concern: tetraethyl pyrophosphate (TEPP) and sulfotep (STEPP). TEPP was not detected above the limit of detection (5 ppm). Detectable levels of STEPP ranged from 3.42 to 14.69 ppm. The limit of detection for STEPP is 3 ppm.

Based on the manufacturing process, composition of raw materials and the chemical structure of phosalone, the technical grade active ingredient is not expected to contain other impurities of toxicological concern as identified in Section 2.13.4 of Regulatory Directive DIR98-04 or other TSMP Track 1 substances as identified in Regulatory Directive DIR99-03, Appendix II.

2.2 Description of Registered Uses of Phosalone

2.2.1 Type of Pesticide

Phosalone is an organophosphate insecticide.

2.2.2 Summary of Registered Use Sites

In Canada, commercial and domestic class end-use products containing phosalone are registered for use on the same food crops including apple, cherry, grape, peach, pear, plum and prune plum crops. Phosalone is not registered in the United States.

2.2.3 Target Pests

The arthropod pests on currently registered phosalone labels belong to the following groups: beetles, bugs, butterflies and moths, flies, and mites. All insects and mites currently listed on the registered labels were included in the assessment of value. Not all pests are registered for all crops.

2.2.4 Formulation Types Registered

End-use products containing phosalone are formulated as suspensions.

2.2.5 Method and Rates of Application

Equipment
In agriculture, orchard and vineyard sprayers are used to apply phosalone products.

Method and Rate

For commercial and domestic class end-use products, the application rate to apple, cherry, peach, pear, plum and prune plum crops is 1000–1500 g of the active ingredient per hectare. Applications are made to the foliage, with a maximum of three applications per season for commercial class end-use products and no maximum stated number of applications for domestic class end-use products. Foliar applications to grapes can be made at a rate of 1000 g of the active ingredient per hectare. A maximum of three applications per season is allowed for commercial class end-use products and a maximum of four applications per season is allowed for domestic class end-use products. Commercial class end-use products can be applied up to 30 days (apples, peaches, pears, plums and prune plums), 21 days (grapes) and 14 days (cherries) before harvest. Domestic class end-use products can be applied up to 21 days (peaches), 14 days (grapes and plums) and 7 days (apples, cherries and pears) before harvest.

3.0 Effects Having Relevance to Human Health

3.1 Toxicology Summary

The toxicology database supporting phosalone is based primarily on studies available from the registrant. In laboratory animals, phosalone was highly acutely toxic to rats via the oral and dermal route and slightly toxic via the inhalation route. It was moderately irritating to eyes, mildly irritating to skin and was not found to be a skin sensitizer. Acute toxic signs induced by phosalone via the oral route are consistent with signs of cholinesterase intoxication and include tremors, salivation, piloerection, decreased activity, gait abnormalities, hypothermia and death. With oral exposure, phosalone was readily absorbed and rapidly eliminated, primarily in the urine, with little tissue retention. Metabolism proceeds via four routes of metabolism with the dominant pathway yielding the sulfate conjugate of 2-amino-5-chlorophenol as its end product. Phosalone oxon is believed to be a transient metabolite formed through one of the secondary metabolic pathways and is likely responsible for the majority of the cholinergic effects of phosalone. While phosalone oxon is more acutely toxic than phosalone, acute studies indicate that its sulfoxide and sulfide metabolites are less toxic.

Following both single and repeated dosing of phosalone, one of the most sensitive indicators of toxicity was the inhibition of acetylcholinesterase, an enzyme necessary for the proper functioning of the nervous system. Rat and dog appeared to show comparable sensitivity to phosalone with the mouse showing the least sensitivity. No appreciable gender differences were noted in the database. Cholinergic signs of toxicity and reduced body-weight gain were also observed at higher doses.

Phosalone demonstrated no evidence of carcinogenic potential in rats and mice following chronic dosing, although it is plausible that higher doses could have been used in the mouse carcinogenicity study. A battery of genotoxicity assays indicates that phosalone is not genotoxic.

In acute and subchronic oral neurotoxicity studies in rats, no treatment-related neuropathy was evident although cholinergic signs of toxicity were demonstrated. No histopathological findings of neuropathy were evident in the remainder of the database in rodents. In acute and subchronic neurotoxicity studies with hens, there was no apparent evidence that phosalone induced delayed neurotoxicity.

Phosalone treatment did not result in changes in reproductive parameters. Offspring toxicity included decreased viability and weight gain. Parental toxicity included plasma and erythrocyte cholinesterase inhibition. Although brain cholinesterase activity was not measured in the reproduction study, the remaining database strongly suggests that brain cholinesterase would be inhibited in the parental animals at the level eliciting the offspring toxicity. In the developmental studies, no teratogenic effects were observed in rats or rabbits. In rats, increased postimplantation loss due to embryonic resorptions was noted at a level which elicited maternal toxicity (clinical signs and reduced weight gain). Maternal rabbits also exhibited clinical signs of neurotoxicity but no adverse developmental findings were observed. Cholinesterase activity was not determined in either study but it is likely that significant inhibition was occurring given the clinical signs. Overall, there was no increased susceptibility of offspring to in utero or post-natal exposure to phosalone.

STEPP was identified as an impurity of toxicological concern in technical grade phosalone. The PMRA assumed that STEPP was present in all phosalone toxicological test material and that risk from exposure to phosalone and STEPP has not been underestimated.

Reference doses for the general population have been set based on no observed adverse effect levels (NOAELs) for the most relevant endpoints, namely acetylcholinesterase inhibition and/or signs of cholinergic toxicity. These reference doses incorporate various uncertainty factors to account for extrapolation between rats and humans as well as for variability within human populations. Separate reference doses have been established, where necessary, for females 13 years and older with additional safety factors to protect pregnant females and their unborn children from identified endpoints of concern.

The toxicology end points used in the risk assessment of phosalone are summarized in Appendix I.

3.2 Occupational and Residential Risk Assessment

Occupational and residential risk is estimated by comparing potential exposures with the most relevant endpoints from toxicology studies to calculate a MOE. This is compared to a target MOE incorporating safety factors protective of the most sensitive subpopulation. If the calculated MOE is less than the target MOE, it does not necessarily mean exposure will result in adverse effects. However, mitigation measures will be necessary to reduce exposure.

For short- and intermediate-term dermal and inhalation risk assessments, the lowest observed adverse effect level (LOAEL) of 3.9 mg/kg bw/day from an oral 13-week rat neurotoxicity study was selected for all populations. Effects on brain cholinesterase and functional observational battery tests were noted at this level. The target MOE selected when using the 13-week neurotoxicity study is 300, which includes 10× for interspecies extrapolation, 10× for intraspecies variability and 3× for the use of a LOAEL instead of a NOAEL. This target MOE is considered protective of females of child-bearing age and their fetuses or nursing infants.

A dermal absorption value was incorporated into the dermal estimates of exposure for all scenarios. As no dermal absorption studies were submitted to the PMRA, a default dermal absorption factor of 50% was based on a comparison of oral and dermal toxicity and the physical-chemical properties of phosalone, including a high log K_{ow} and a low water solubility.

3.2.1 Occupational Mixer/Loader/Applicator Exposure and Risk Assessment

There are potential exposures to mixers, loaders, applicators and other handlers. Based on typical use patterns, the major scenarios identified were the following:

- mixing/loading suspension for application to fruit trees and grapes; and
- applying suspension as sprays to fruit trees and grapes by airblast sprayer.

No chemical-specific handler exposure data were submitted for phosalone; therefore, dermal and inhalation exposure were estimated for the various application methods using the Pesticide Handlers Exposure Database Version 1.1 (PHED). The PHED is a compilation of generic mixer/loader/applicator passive dosimetry data with associated software that facilitates the generation of scenario-specific exposure estimates, based on formulation type, application equipment, mix/load systems and level of personal protective equipment.

In most cases, the PHED did not contain appropriate data sets to estimate exposure to workers wearing chemical-resistant coveralls, chemical-resistant headgear or a respirator. This was estimated by incorporating a 90% protection factor for chemical-resistant coveralls and/or chemical-resistant headgear and a 90% protection factor for a respirator into the unit PHED exposures.

The PMRA estimated handler exposure based on different levels of personal protective equipment (PPE) and engineering controls.

- Minimum personal protective equipment (current label PPE): long-sleeved shirt and long pants, chemical-resistant gloves, respirator.

- Maximum personal protective equipment: chemical-resistant coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, respirator.

- Engineering controls: closed mixing/loading, closed tractor cab for application, long-sleeved shirt and long pants, chemical-resistant gloves, respirator.

- Combination: closed mixing/loading with coveralls over long sleeved shirt and long pants, chemical-resistant gloves and respirator; open cab application with chemical-resistant coveralls over long-sleeved shirt and long pants, chemical-resistant head gear, chemical-resistant gloves and respirator.

Mixer, loader and applicator exposure estimates are based on the best available data at this time. The assessment might be refined with exposure data more representative of modern spray equipment and engineering controls.

Based on the phosalone use pattern, mixer/loader/applicator exposure scenarios were considered to be short- to intermediate-term (up to three months) in duration.

As both dermal and inhalation exposure shared the same LOAEL and target MOE a combined MOE was calculated. Combined MOEs are summarized in Table 1 of Appendix II.

For all exposure scenarios, calculated MOEs for mixer/loader/applicators were above the PMRA target of 300 with engineering controls (closed cab and closed mix/load) or a combination of closed mixing/loading, open cab application, chemical-resistant coveralls and headgear; therefore, the MOEs were considered acceptable.

All proposed regulatory actions are described in detail in Section 7.0.

3.2.2 Occupational Postapplication Exposure and Risk Assessment

The postapplication occupational risk assessment considered exposures to workers who re-enter treated sites to conduct agronomic activities involving foliar contact (e.g., pruning, thinning, harvesting or scouting). Based on the phosalone use pattern, there is potential for short- to intermediate-term (up to three months) postapplication exposure by the dermal route. Inhalation exposure is considered to be negligible compared with dermal exposure because phosalone has a low vapour pressure (1.0×10^{-6} mm Hg at 25°C).

Potential exposure to re-entry workers was estimated using activity specific transfer coefficients (TCs) and dislodgeable foliar residue (DFR) studies. 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 registrant is a member of the Agricultural Reentry Task Force, so the refined TCs of the Agricultural Reentry Task Force were used.

Seven DFR studies were submitted to and reviewed by the PMRA; all were found to have significant limitations that prevented them from being used in a quantitative manner.

When used qualitatively, the peak DFR residues in the studies were fairly similar to the default peak DFR values used in this assessment, which were derived from 20% of the application rate. Normally, when there is a lack of suitable studies, a default dissipation value of 10% per day is used, which gives a half-life of about 7 days. Based on a qualitative analysis of the submitted DFR studies, a dissipation rate of 3.5% per day was assumed, which equates to a half-life of 20 days. It should be noted that with such a long half-life, phosalone residues are likely to accumulate with multiple applications.

Postapplication risk is managed by establishing a restricted entry interval for specific tasks. Pesticide residues dissipate and/or breakdown over time and a restricted entry interval is the length of time required for the dislodgeable pesticide residues to dissipate to such a level that entry into a treated area does not result in unacceptable exposure.

Postapplication exposure and risk estimates, based on the currently available data, are presented in Table 2 of Appendix II. For both low and high application rates, calculated MOEs for most postapplication activities at the current restricted entry intervals are below the PMRA target of 300. Restricted entry intervals would need to be significantly increased in length to achieve the target MOEs, to 1–93 days at the low application rate and 8–127 days at the high rate. These restricted entry intervals estimates are based on the dissipation of phosalone residues after one application. As these are greater than what is considered to be agronomically feasible, multiple application scenarios were not examined. As noted above, residues would accumulate across multiple applications, resulting in even longer required restricted entry intervals.

The estimated postapplication exposures are qualitatively supported by the results of a grape harvester biomonitoring study conducted in California (Baugher 1989). The study measured the effects of exposure on plasma and red blood cell cholinesterase activity. Thirty harvesters began work 14 days after phosalone application and harvested for 6 consecutive days. During this time, levels of plasma cholinesterase decreased significantly to less than 70% of mean baseline for most of the harvesters and to a minimum of 25% of the baseline in one individual. As well, ethyl alkylphosphate residues appeared in the urine in significant amounts during the time of exposure. These results are of concern, especially because the study may have underestimated exposure due to a spray wash off program initiated by the sponsor. The program involved spraying the treated grapes with water three days prior to harvesting with the intent of removing a significant portion of the phosalone residues from the grape leaves.

Table 3, in Appendix II, shows calculated MOEs for restricted entry interval considered agronomically feasible, which range from 3 to 30 days for most crops. Target MOEs are not met for any scenarios except “hand weeding, propping, animal control and baiting” at the low rate.

3.3 Residential Exposure and Risk Assessment

Residential risk assessment is concerned with estimating risks to the general population, including children, during or after pesticide application.

3.3.1 Residential Mixer/Loader/Applicator Exposure

The residential mixer/loader/applicator risk assessment considered exposure to adults mixing, loading, and applying phosalone to fruit trees in a residential setting.

Dermal and inhalation exposure estimates are based on the Pesticide Handlers Exposure Database (PHED) and an Outdoor Residential Exposure Task Force (ORETF) study. Limitations are identified below.

Residential exposure and risk estimates are presented in Table 1 of Appendix III. The calculated MOE for high pressure handwand application was above the PMRA target of 300. However this may be an underestimate of homeowner exposure because surrogate PHED data, which includes gloves in the unit exposure, were used in the calculation. Calculated MOEs for application by handheld sprayer and hose-end sprayer exposure scenarios were above the PMRA target of 300 for all scenarios. Application by backpack was not assessed, as the PHED backpack scenario is based on treating low- to mid-level crops, severely underestimating the potential exposure to the head and upper body likely to occur when treating trees.

3.3.2 Residential Postapplication Exposure

Two postapplication dermal exposure scenarios were considered: exposure to adults and adolescents harvesting fruit immediately after application; and exposure to adults and adolescents while thinning fruit trees immediately after application. Inhalation exposure is not considered to be a significant postapplication route of exposure compared to dermal routes.

Postapplication exposure to treated fruit trees was estimated following the USEPA *Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments* and the recommended revisions by the USEPA Science Advisory Council, as well as using generic transfer coefficients and phosalone-specific dislodgeable foliar residue (DFR) estimates, as outlined in Section 3.2.2. The assumptions outlined in the SOP generally result in high-end estimates of exposure.

The dermal MOEs are summarized in Table 2 of Appendix III. Calculated MOE's for all residential postapplication scenarios were below the PMRA target of 300. The MOEs in the table were based upon residues estimated following a single application. As noted previously, residues would likely accumulate across multiple applications, resulting in even lower calculated MOEs.

Residential postapplication exposure would be similar after either homeowner application of domestic products or professional application of commercial products as the label application rates of domestic and commercial products are similar.

3.4 Dietary Exposure and Risk Assessment

In a dietary exposure assessment, the PMRA determines how much of a pesticide residue, including residues in fruits, vegetables, milk, meat, eggs and processed products, may be ingested with the daily diet. These dietary 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, assessments take into account differences in children's eating patterns, such as greater consumption of fruit, vegetables and juices relative to their body weight compared with adults.

Acute and chronic dietary exposure and risk estimates for phosalone were generated using the Dietary Exposure Evaluation Model (DEEM) and updated consumption data from the United States Food and Drug Administration (USFDA) Continuing Survey of Food Intakes by Individuals (1994–1998).

Acute dietary risk is calculated using food consumption and food residue values. A probabilistic statistical analysis allows all possible combinations of food consumption and residue levels to be combined to estimate a distribution of the amount of phosalone residue that might be eaten in a day. An exposure value representing the high end (99.9^{th} percentile) of this distribution is compared with the acute reference dose (ARfD), which is the dose at which an individual could be exposed on any given day and expect no adverse health effects. When the calculated intake, called the potential daily intake, from residues is less than the ARfD, the intake is not considered to be of concern.

To estimate acute dietary risk (1-day) for the general population, the NOAEL of 10 mg/kg bw from the acute neurotoxicity study in rats was selected for risk assessment. This NOAEL is based on clinical signs of cholinergic toxicity at the LOAEL of 25 mg/kg bw. Standard uncertainty factors (10× for interspecies extrapolation and 10× for intraspecies variability) were used, providing a total uncertainty factor of 100. No additional uncertainty or safety factors were deemed necessary as the database was considered adequate. The ARfD was calculated to be 0.1 mg/kg bw (10 mg/kg bw ÷ 100). This reference dose was considered protective of infants and children.

To estimate acute dietary risk (1-day) for females 13 years and older, the NOAEL of 10 mg/kg bw/day from the rat developmental study was selected for risk assessment. In this study, the developmental endpoints were severe (increased resorptions and postimplantation loss) but were noted in the presence of maternal toxicity. Standard uncertainty factors (10× for interspecies extrapolation and 10× for intraspecies variability) were used as well as a safety factor of 3× for the severity of the endpoint, providing a total factor of 300. The ARfD was calculated to be 0.03 mg/kg bw (10 mg/kg bw ÷ 300). This reference dose was considered protective of pregnant women and their fetuses.

The acute dietary exposure was calculated using a refined probabilistic assessment. Refinements for commodities on which phosalone is registered for use in Canada or those that may potentially be imported into Canada (i.e., the commodity has an established American tolerance or Codex MRL) included generating residue distribution files that incorporated the following, where appropriate:

- Canadian (CFIA) and American (USFDA and Pesticide Data Program) monitoring data;
- empirical data from magnitude of residue (MOR) studies;
- processing studies;
- percent commodity treated estimates; and
- anticipated residues data generated in the United States.

Acute dietary risk from foods treated with phosalone was not a concern for the general Canadian population and all population subgroups (i.e., less than 100% of the ARfD is consumed). At the 99.9th percentile of exposure, the most highly exposed population subgroups, nursing females and non-nursing infants (<1 year old), consume 17% and 12% of their respective ARfD, in their food. All other subpopulations have potential dietary intakes of less than 12% of the ARfD.

The chronic dietary risk was calculated by using the average consumption of different foods and average residue values on those foods, over a 70-year lifetime. This expected intake of residues is compared with the acceptable daily intake (ADI), which is the dose that an individual could be exposed to over a lifetime and expect no adverse health effects. When the expected intake from residues is less than the ADI, the expected intake is not considered to be of concern.

To estimate dietary risk from repeat or chronic exposure, a cumulation of repeat dose studies was examined for the current risk assessment, and included a 56-day rat, a 28-day dog, a 1-year dog and a reproductive toxicity study. A NOAEL of 0.9 mg/kg bw/day was established, based upon effects on brain cholinesterase inhibition at higher dose levels. Standard uncertainty factors of 10× for interspecies extrapolation and 10× for intraspecies variability were used. No additional uncertainty or safety factors were deemed necessary as the database was considered adequate and there was no evidence of sensitive populations. The ADI was calculated to be 0.009 mg/kg bw/day (0.9 mg/kg bw/day ÷ 100).The selection of the ADI and margins of safety are considered to be protective of all subpopulations including pregnant women and children.

The chronic dietary exposure was calculated using a refined deterministic assessment. Refinements for commodities on which phosalone is registered for use in Canada or those that may potentially be imported into Canada (i.e., the commodity has an established American tolerance or Codex MRL) included incorporating, where appropriate, mean residue from MOR studies, Canadian and American monitoring data, percent commodity treated estimates and anticipated residues data generated in the United States. Chronic dietary risk from foods treated with phosalone is not a concern for the general Canadian

population or any population subgroup (i.e., less than 100% of the ADI is consumed). The most highly exposed population subgroups, children (1–6 years old) and nursing females consume 4% and 3% of the ADI in their food, respectively. All other subpopulations had potential daily intakes less than 2% of the ADI in their food.

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, other non-occupational sources, and from all known or plausible exposure routes (oral, dermal and inhalation). Aggregate risk assessments can be conducted for various exposure periods.

Because residential exposure to adults and youths performing postapplication activities, such as thinning or harvesting do not meet the target MOE, no aggregate risk assessment incorporating residential exposure was performed.

Acute and chronic aggregate risk from food and drinking water exposure was addressed by calculating drinking water levels of comparison (DWLOCs). DWLOCs are based on the difference between the appropriate reference dose and the non-drinking water exposure and can be directly compared to estimated concentrations in drinking water.

The calculated acute DWLOC values ranged from 774 µg/L for the most sensitive subpopulation (nursing females) to 3415 µg/L for males 20 years and older. The chronic DWLOCs ranged from 88 µg/L for the most sensitive subpopulation (non-nursing infants) to 312 µg/L for males 20 years and older. Estimated environmental concentrations (EECs) for drinking water, based on screening level models, were 0 µg/L for groundwater (acute and chronic) and 43.2 and 5 µg/L for acute and chronic concentrations in surface water (Section 5.3). As the EECs for drinking water do not exceed the relevant DWLOCs, residues of phosalone in drinking water, when considered along with dietary exposure, do not result in aggregate risk estimates that exceed the level of concern.

These drinking water, chronic and acute dietary risk assessments demonstrated that there are no dietary health concerns for any subpopulation in Canada, including infants, children, teenagers, adults and nursing or pregnant females.

4.0 Environmental Assessment

The environmental risk assessment on phosalone has been largely based on the information contained in the ecotoxicological evaluation of phosalone by the Norwegian Agricultural Inspection Service. Information contained in the open literature and from USEPA fact sheets were also used.

In assessing the environmental risk of phosalone, an initial deterministic assessment was conducted. In this assessment, risk was characterized by the quotient method, calculated as the ratio of the estimated environmental concentration to the effects endpoints of concern. Quotient values less than one are considered indicative of a low risk to non-target organisms, whereas values greater than one are considered to indicate that some degree of risk exists for non-target organisms.

In this initial deterministic assessment, estimated environmental concentrations for aquatic and terrestrial ecosystems were determined for orchard uses of phosalone based on the range of application rates and number of applications listed on the current registered labels. Toxicity endpoints (acute and chronic) were chosen for the most sensitive species tested and used as surrogates for the wide range of species that can be potentially exposed following treatment with phosalone.

4.1 Environmental Fate

Phosalone has a solubility in water of 3.05 mg/L at 25°C, classifying it as having a low solubility. The vapour pressure of 1.0×10^{-6} mm Hg at 25°C indicates that phosalone is relatively non-volatile under field conditions. The calculated Henry's Law constant of 1.59×10^{-7} atm·m^3/mole and the calculated 1/H value of 1.4×10^5 indicate that phosalone is unlikely to volatilize from water or moist soil surfaces. Phosalone is a non-ionic compound and, therefore, will not dissociate at environmentally relevant pHs (approximately 5.0 to 9.0). Phosalone has a log K_{ow} of 4.01 at 20°C, indicating that it has a potential for bioaccumulation. Laboratory studies have shown that phosalone does bioconcentrate in fish and bioaccumulate in mammals, but that residues are rapidly metabolized and eliminated.

Phosalone is stable to transformation by hydrolysis at pH 5 and pH 7, but is readily hydrolyzed at pH 9. Phototransformation on soil is not an important route of transformation of phosalone in the environment. Due to lack of adequate information, the importance of phototransformation of phosalone in water is unclear.

Laboratory aerobic biotransformation studies conducted on four soils resulted in dissipation time to 50% (DT_{50}) for phosalone ranging from 0.8 to 4.1 days, classifying it as non-persistent. The DT_{50} was 3–7 days in a fine sandy-loam flooded soil. It cannot be definitely concluded that aerobic and anaerobic biotransformation are important routes of transformation in soil because of the high percentage of bound residues observed, which could be either parent compound or transformation products. In the aquatic environment, the DT_{50} for phosalone in two water/sediment systems was less than one week. No major transformation products (>10% of the applied a.i.) were observed in water or sediment. There was a high percentage of bound residues observed in sediment, and the observed rapid dissipation may have occurred due to partitioning from the water phase into sediment. No data were available to determine the anaerobic aquatic biotransformation of phosalone.

Adsorption/desorption studies indicated that phosalone is classified as slightly mobile in sandy-loam and loam soil and as having a low mobility in silty-clay loam soil. The transformation product phenoxazone is classified as having low mobility in sandy-loam soil and slight mobility in silty-clay loam and silty-clay soil. A laboratory soil column leaching study indicated that phosalone residues remained in the top soil layer and did not leach after aging.

No data were available on the terrestrial or aquatic dissipation of phosalone under Canadian or equivalent American field conditions.

4.2 Environmental Toxicology

The 14-day lethal concentration to 50% (LC_{50}) to earthworms (*Eisenia foetida*) was reported as 45 mg a.i./kg soil. The no observed effect concentration (NOEC) was reported as 1.0 mg a.i./kg soil. Phosalone is classified as moderately toxic to the honey bee (*Apis mellifera)* with reported 48-h contact and oral lethal doses to 50% (LD_{50}) of 3.6 and 7.4 µg a.i./bee, respectively. Phosalone is practically non-toxic (LD_{50}s >2150 mg a.i./kg bw) to slightly toxic (LD_{50} 503 mg a.i./kg bw) on an acute oral basis and slightly toxic (LC_{50}s 1659–2552 mg a.i./kg diet) to birds on an acute dietary basis. In chronic reproduction studies, a treatment related effect on body weight and possible effect upon egg production was observed in bobwhite quail (*Colinus virginianus)* at 411 mg a.i./kg diet. The NOEC was reported as 137 mg a.i./kg diet. A marked effect upon the body weights, an increase in the number of hens with immature ovaries at terminal necropsy and a possible effect upon egg production was observed in mallard ducks (*Anas platyrhynchos*) at 450 mg a.i./kg diet. The reported NOEC was 50 mg a.i./kg diet. Phosalone is considered moderately toxic (LD_{50}s 90–93 mg a.i./kg bw) to mammals on an acute oral basis.

Phosalone is considered very highly acutely toxic to freshwater aquatic invertebrates (48-h LC_{50} 0.739 µg a.i./L); highly acutely toxic to cold freshwater fish, e.g., rainbow trout (96-h LC_{50} 630 µg a.i./L), very highly acutely toxic to warm freshwater fish, e.g., bluegill sunfish (96-h LC_{50} 50 µg a.i./L); and highly acutely toxic to estuarine and marine invertebrates (96-h EC_{50} 900 µg a.i./L). The 21-day NOEC for *Daphnia magna* was reported as 0.136 ug a.i./L. No chronic effects data are available for fish.

4.3 Concentrations in Drinking Water

Residues of phosalone in potential drinking water sources (groundwater, reservoirs and dugouts) at Level 1 were modelled using the Leaching Estimation and Chemistry Model (LEACHM) for groundwater and Pesticide Root Zone Model/Exposure Analysis Modeling System (PRZM/EXAMS) for surface water. LEACHM predicted that phosalone will not reach groundwater (estimated EEC is 0 µg a.i./L). Results from run-off modelling using PRZM/EXAMS predicted that the acute (yearly peak) and chronic (yearly average) concentrations of phosalone at the 90th percentile to be 43.2 and 5 µg a.i./L for reservoirs, respectively resulting from agricultural uses. These values are

considered to be “upper bound” concentrations in surface water that potentially may be used as a drinking water source. Phosalone was not identified as being used in the prairie region thus, concentrations of phosalone in dugouts were not determined. Phosalone residues have been detected in municipal drinking water sources and groundwater in Prince Edward Island at a concentration of 0.5 µg a.i./L and in ambient water that may serve as a drinking water source in the apple and corn growing regions of Quebec at concentrations of 0.03–0.2 µg a.i./L.

4.4 Terrestrial Risk Assessment

Earthworms would be considered to be at low to moderate risk from applications of phosalone to control insect pests on apples and pears based on the calculated risk quotients ranging from 0.45–1.66. Phosalone is considered to be moderately toxic to honey bees. It should not be applied when bees are foraging in the field or near their colonies.

Using standard exposure scenarios on vegetation and other food sources based on correlations in Hoerger and Kenaga (1972) and Kenaga (1973) that were modified according to Fletcher et al. (1994) and the acute dietary toxicity of phosalone to birds, risk quotients ranged from 0.06 to 0.46, classifying it as having negligible to low risk. Assessment of chronic toxicity to birds resulted in risk quotients, ranging from 0.68 to 3.35. Based on the assessment, phosalone is classified as having a low to moderate chronic risk for birds, depending on the application rate and number of applications. The available acute dietary and chronic toxicity data, however, are for waterfowl and upland game birds and do not allow an assessment of the effects on smaller bird species such as songbirds, which are more typical in the agricultural areas where phosalone is used. Smaller species are usually more sensitive than either the bobwhite quail or the mallard duck.

Based on correlations in Hoerger and Kenaga (1972) and Kenaga (1973) that were modified according to Fletcher et al. (1994), the risk to small mammals from exposure to phosalone on an acute dietary and chronic reproductive basis using standard exposure scenarios on vegetation and other food sources is high to very high according to calculated risk quotients, which ranged from 10 to 132. There is much uncertainty, however, concerning this assessment because it does not consider feeding preference or avoidance behaviour toward contaminated food as these data are not currently available. Studies with rats and mice have also shown that phosalone is rapidly metabolized and excreted. Thus, more realistic exposure scenarios are required to refine the risk assessment for small mammals.

4.5 Aquatic Risk Assessment

In this initial deterministic assessment, risk quotients for aquatic organisms were calculated for aquatic invertebrates, fish and algae. EECs in water were calculated for the different rates and numbers of applications assuming a direct overspray to a body of water 30 cm deep. The effects endpoint used was the NOEC of the most sensitive species tested. In general, risk quotients were very high for both aquatic invertebrates and fish for all application rates. For freshwater fish, these ranged from 68 to 150 for acute effects and from 6.1 to 13.4 for prolonged effects, indicating a moderate to very high risk. For aquatic invertebrates, risk quotients ranged from 1620 to 3550 for acute effects and from 2500 to 5510 for chronic effects, indicating an extremely high risk. For freshwater algae, quotients ranged from 3.4 to 7.5 indicating a moderate risk.

4.6 Environmental Assessment Conclusions

The initial deterministic terrestrial assessment concluded that acute and chronic risks from orchard uses of phosalone ranged from low to moderate for earthworms, beneficial insects (e.g., bees) and birds. The acute and chronic risk to small mammals ranged from high to very high. However, there is much uncertainty concerning this assessment because it does not consider feeding preference or avoidance behaviour toward contaminated food as these data are not currently available.

The initial deterministic assessment concluded that acute and chronic risks from the use of phosalone ranged from moderate to extremely high for freshwater aquatic organisms (fish, aquatic invertebrates and algae).

The PMRA recognizes the uncertainty associated with the initial environmental assessment of phosalone. While the toxicity of phosalone is relatively well characterized for most organisms, the concentrations to which non-target organisms are exposed are less certain. Current assessment approaches do not allow analyses of the frequency or magnitude of effects.

Within the pesticide regulatory community involved with environmental risk assessments, a considerable amount of work is currently being done to refine the approaches and methods used for the environmental assessments of pest control products. The PMRA has been involved in these efforts together with the USEPA. The refined methods to characterize risk are based on probabilistic risk assessment, which will provide a more thorough picture of the risk and associated uncertainties.

5.0 Value

5.1 Agricultural Uses of Phosalone

The importance of end-use products containing phosalone in managing specific pests on specific crops in Canada was evaluated based on the availability of registered pesticides that are potential alternatives. The use of phosalone in agriculture in recent years in Canada was assessed by surveying crop production specialists, provincial agricultural officials, growers' associations and other stakeholders about phosalone use in 1998 and in 2001. The results of those surveys show that there is little reported use of products containing phosalone in Canada.

5.2 Domestic Uses of Phosalone

The PMRA has no information about the use of the domestic class end-use products containing phosalone. Alternative active ingredients are registered for the domestic uses of phosalone.

6.0 Other Assessment Considerations

6.1 Toxic Substances Management Policy

The PMRA has taken into account the federal Toxic Substances Management Policy (TSMP) during the review of phosalone. It has been determined that phosalone does not meet the TSMP Track 1 criteria for the following reasons.

- The reported half-life values in soil (1–5 weeks) and water/sediment (<1 week) are below the TSMP Track 1 cut-off criteria for persistence (≥ 6 months).
- Data on persistence in air are not triggered.
- The reported log K_{ow} for phosalone (4.01) falls below the TSMP Track 1 cut-off criterion for bioaccumulation (log $K_{ow} \geq 5.0$).

No data were provided on the persistence of phosalone in sediment.

6.2 Formulant Issues

Formulant issues are being addressed through the PMRA formulant initiatives or the formulant policy under development, as outlined below.

- List 1 formulants are subject to removal from products as communicated to registrants of affected products in September 2001.

- Registrants of products containing nonylphenol ethoxylates are requested to replace nonylphenol ethoxylates with less harmful alternatives.

- Other formulants including List 2 formulants, formulation preservatives and allergens are subject to regulatory action as outlined in Regulatory Directive DIR2004-01, *Formulants Program.*

7.0 Proposed Regulatory Action

Based on the available information, the PMRA has determined that the calculated MOEs for occupational and residential postapplication risks are of concern. Furthermore, based on a survey conducted in 1998 and consultations with provincial crop specialists in 2001, the PMRA determined that there is little reported use of products containing phosalone in Canada. As a result, the PMRA is proposing that phosalone use be phased out unless further data are provided to demonstrate acceptable postapplication risk.

The PMRA will accept written comments up to 60 days from the date of publication of this consultation document to allow interested parties an opportunity to provide input into the proposed re-evaluation decision for these products. The outcome of this assessment will be the subject of the future PMRA decision document. If required, the PMRA is willing to consult with stakeholders on transition issues related to pest control product needs.

7.1 Residue of Concern Definition

Division 15, Table II, of the Food and Drug Regulations currently defines the parent compound phosalone (S-6-chloro-2,3-dihydro-2-oxobenzoxazol-3-ylmethyl *O,O* -diethylphosphorodithioate) as the residue of concern (ROC). No change is proposed for the ROC definition. This ROC is consistent with that of the USEPA and Codex.

7.2 Maximum Residue Limits of Phosalone in Food

In general, when the re-evaluation of a pesticide has been completed, the PMRA intends to update Canadian maximum residue limits (MRLs) and to remove MRLs that are no longer supported. The PMRA recognizes, however, that interested parties may want to retain an MRL in the absence of a Canadian registration to allow legal importation of treated commodities into Canada. The PMRA requires similar chemistry and toxicology data for such import MRLs as those required to support Canadian food use registrations. In addition, the PMRA requires residue data (MOR trials) that are representative of use conditions in exporting countries, in the same manner that representative residue data to support domestic use of the pesticide are required. These requirements are necessary so that the PMRA may determine whether the requested MRLs are needed and ensures they would not result in unacceptable health risks.

After the revocation of an MRL, or where there is no specified MRL, the general MRL of 0.1 ppm, as specified in subsection B.15.002(1) of the Food and Drug Regulations, applies for enforcement purposes. Changes to this general MRL may be implemented in the future, as indicated in Discussion Document DIS2003-01, *Revocation of the 0.1 ppm General Maximum Residue Limit for Food Pesticide Residues [Regulation B.15.002(1)]*.

As indicated in Table 7.2, the Food and Drug Regulations specify MRLs for phosalone residues on artichokes, dried apricots, cherries, apples, grapes, plums, apricots, peaches/nectarines, pears and citrus fruits. For these commodities, residue data were available to indicate the existing MRLs should not be exceeded if phosalone is used according to good agricultural practice as described by the current product labels. However, in most cases the existing residue data are dated and do not fully satisfy the requirements as described in Regulatory Directive DIR98-02, *Residue Chemistry Guidelines*.

The PMRA is proposing to phase out all agricultural uses of phosalone unless further data are provided to demonstrate acceptable postapplication risk. Therefore, the Agency is also proposing that all phosalone MRLs be revoked, allowing at least one year after the last date of use for all commodities to clear the channels of trade.

Parties interested in supporting a phosalone MRL for importation of treated commodities should contact the PMRA during the comment period of this document to discuss the submission of appropriate data.

Table 7.2 Phosalone MRLs for Commodities Approved for Treatment in Canada and Import Commodities with Specified MRLs

Commodity	MRL (ppm)
Artichokes*	15
Dried apricots*	12
Cherries	6
Apples, grapes, plums	5
Apricots*, peaches/nectarines	4
Pears	2
Citrus fruits*	1.5

* Import commodities

8.0 Additional Data Requirements

Confirmatory data would be required to support the continued acceptance of phosalone residues on imported foods.

8.1 Data Requirements Relating to Toxicology

- A delayed neurotoxicity study with neuropathy target esterase measurements (DACO 4.5.10)
- A developmental neurotoxicity study (DACO 4.5.14)
- A short-term inhalation study (90-day) (DACO 4.3.6)

8.2 Data Requirements Relating to Food Residue Exposure

- Current phosalone analytical methods (DACO 7.2.1)
- Freezer storage stability (DACO 7.3)
- Crop residue data that meet contemporary standards, as per PMRA Regulatory Directive DIR98-02, *Residue Chemistry Guidelines* (DACO 7.4)

List of Abbreviations

ADI	acceptable daily intake
a.i.	active ingredient
ARfD	acute reference dose
atm	atmospheres
bw	body weight
CAS	Chemical Abstracts Society
CFIA	Canadian Food Inspection Agency
cm	centimetre(s)
DACO	data code
DEEM	Dietary Exposure Evaluation Model
DFR	dislodgeable foliar residue
DT_{50}	dissipation time to 50%
DWLOC	drinking water level of comparison
EEC	expected environmental concentration
EXAMS	Exposure Analysis Modeling System
g	gram(s)
h	hour(s)
H	Henry's Law constant
ha	hectare
kg	kilogram(s)
K_{ow}	*n*-octanol–water partition coefficient
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
L	litre
LOAEL	lowest observed adverse effect level [mg a.i./kg bw]
m	metre
m^3	metre(s) cubed
mg	milligram
mm	millimetre(s)
mm Hg	millimetre mercury
MOE	margin of exposure
MOR	magnitude of residue
MRL	maximum residue limit
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
OP	organophosphate insecticide
ORETF	Outdoor Residential Exposure Task Force
PCPA	*Pest Control Products Act*
PHI	preharvest interval
pH	-log10 hydrogen ion concentration
PHED	Pesticide Handlers Exposure Database
PMRA	Pest Management Regulatory Agency
PPE	personal protective equipment
ppm	parts per million

PRZM	Pesticide Root Zone Model
REI	restricted entry interval
ROC	residue(s) of concern
SOP	Standard Operating Procedures
SRL	safe residue limit
TC	transfer coefficient
TSMP	Toxic Substances Management Policy
URMULE	User Requested Minor Use Label Expansion
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration

Appendix I Toxicology Endpoints for Health Risk Assessment for Phosalone

Exposure Scenario	Dose (mg/kg bw/day)	Endpoint	Study	UF/SF or MOE[a]
Acute dietary—general population	NOAEL = 10	Clinical signs	Acute neurotoxicity—rat	100
	ARfD = 0.1 mg/kg bw			
Acute dietary—females 13+	NOAEL = 10	Resorptions and postimplantation loss	Developmental—rat	300
	ARfD = 0.03 mg/kg bw			
Chronic dietary	NOAEL = 0.9	Brain cholinesterase inhibition	Various oral studies, rat and dog	100
	ADI = 0.009 mg/kg bw/day			
Short[b]- and intermediate[c]-term dermal[d] and inhalation[e]	LOAEL = 3.9 (Oral)	Brain cholinesterase inhibition, altered neurobehaviour	13-week dietary neurotoxicity—rat	300

[a] UF/SF refers to total of uncertainty and/or safety factors for dietary assessments, MOE refers to desired margin of exposure for occupational or residential assessments.

[b] Duration of exposure is 1–30 days.

[c] Duration of exposure is 1–3 months.

[d] Because an oral NOAEL was selected, a dermal absorption factor of 50% should be used in route-to-route extrapolation.

[e] Because an oral NOAEL was selected, an inhalation absorption factor of 100% (default value) should be used in route-to-route extrapolation.

Appendix II Occupational Risk Estimates for Phosalone

Table 1 Margins of Exposure for Mixers/Loaders/Applicators

Application Method	Crop	Rate (kg a.i./ha)	Area Treated (ha/day)	Combined MOEs[a]			
				Min. PPE[b]	Max. PPE[c]	EC[d]	Comb[e]
Mixer/Loader/Applicator					**Target: 300**		
Airblast	Apple (apple maggot)	1.5	16	40	45	365	316
	Pear (apple maggot)	1.5	6[f]	100	120	980	900
	Plum, prune (apple maggot)	1.5	4[g]	150	180	1465	1350
	Cherry	1.5	16	40	45	365	316
	Peach	1.5	16	40	45	365	316
	Grape	1	16	55	70	560	500

(Shading indicates calculated MOEs that are less than target MOEs)

[a] Combined MOE = 1/[1/dermal MOE + 1/inhalation MOE]. Based on an oral LOAEL of 3.9 mg/kg bw/day and a target MOE of 300; dermal absorption = 50%.

[b] Minimum PPE (current label PPE) = long-sleeved shirt, long pants, respirator and chemical-resistant gloves.

[c] Maximum PPE = label PPE with chemical-resistant coveralls.

[d] EC = engineering controls; closed mixing/loading, closed tractor cab for application, label PPE.

[e] Combination = closed mix/load, open cab, maximum PPE with chemical-resistant headgear.

[f] Refinement of default area treated per day. Based on Canadian crop statistics[1] that showed that the average of the largest farms (99.9th percentile) are approximately 4.5 ha, so the value of 6 ha was used to account for those farms larger than the average.

[g] Refinement of default area treated per day. Based on Canadian crop statistics[1] that showed that 127 farms at Niagara-on-the-Lake averaged 2 ha. As this is an average, there are some farms that are larger than 2 ha. The estimate of twice the average farm size was used in this assessment.

[1] Statistics Canada. 2002. *2001 Census of Agriculture*. Statistics Canada. Ottawa, Ontario.

Table 2 Margins of Exposure for Workers Entering Treated Fields on Day 1, After a Single Application[a]

Activity	Transfer Coefficient (cm^2/hr)[a]	Rate (kg a.i./ha)	MOE[b] (Day 1)		REI[c,d]	
			Low Rate	High Rate	Low Rate	High Rate
Orchard Worker			**Target: 300**			
Cane turning, tying, girdling (table grapes only)	10000	1	N/A	**4**	N/A	**127**
Hand harvesting, hand pruning, training, thinning (juice/wine grapes only)	5000	1	N/A	**7**	N/A	**108**
Hand thinning	3000	1.0–1.5	**12**	**8**	**93**	**105**
Hand harvesting	1500	1.0–1.5	**24**	**16**	**84**	**85**
Mechanical harvesting (cherries only)	200	1.0–1.5	**180**	**120**	**16**	**28**
Hand pruning, scouting, pinching, tying, training	500	1.0–1.5	**71**	**47**	**42**	**54**
Hand weeding, propping, animal control, baiting	100	1.0–1.5	**350**	**240**	**1**	**8**

(Shading indicates calculated MOEs that are less than target MOEs)

[a] A single application greatly underestimates actual exposure, because label allows three applications per season and residues are expected to accumulate as phosalone dissipates slowly.

[b] Based on an oral LOAEL of 3.9 mg/kg bw/day with a target MOE of 300; dermal absorption = 50%.

[c] The REI is the length of time that it takes for the dissipation to reach the safe residue limit (SRL), which is calculated using the following equation: SRL ($\mu g/cm^2$) = NOAEL ($\mu g/kg$) × bw (kg) / TC (cm^2/hr) × exposure time (hrs) × safety factor

[d] DFR studies submitted to the PMRA contained significant limitations, as such they were used qualitatively rather then quantitatively. A peak default DFR value of 20% of the application rate was used, as it was comparable to peak residues in the submitted DFR studies. A dissipation rate of 3.5% per day was used, as it corresponds to the half-life of 20 days determined qualitatively from the submitted DFR studies.

Table 3 Margins of Exposure for Workers Entering Treated Fields on the Agronomically Feasible Restricted Entry Interval (REI)

Activity	Agronomically Feasible REI[a]	MOE[b] (at REI)	
		Low Rate	High Rate
Orchard worker		**Target: 300**	
Cane turning, tying, girdling (table grapes only)	3	N/A	**7**
Hand harvesting (juice grapes only)	21[c]	N/A	**15**
Hand pruning, training, thinning (juice grapes only)	3	N/A	**8**
Thinning	3	**13**	**8**
Hand harvesting (apples, pears, peaches, plums/prunes)	30[c]	**65**	**45**
Hand harvesting (cherries)	14[c]	**40**	**25**
Mechanical harvesting (cherries only)	14[c]	**280**	**185**
Hand pruning, scouting, pinching, tying, training	3	**75**	**50**
Hand weeding, propping, animal control, baiting	3	**380**	**250**

(Shading indicates calculated MOEs that are less than target MOEs)

[a] Restricted entry interval that is determined to be agronomically feasible by the PMRA. Three days following application was used for most activities in this assessment; the preharvest interval (PHI) was used for harvesting.

[b] Based on an oral LOAEL of 3.9 mg/kg bw/day with a target MOE of 300; dermal absorption = 50%.

[c] The PHI for cherries (14 days following application); grapes (21 days); apples, pears, peaches, plums/prunes (30 days)

Appendix III Residential Risk Estimates for Phosalone

Table 1 Margins of Exposure for Residential Mixers/Loaders and Applicators

Application Equipment	Data Source[a]	Crop	Rate (low and high) (g a.i./L)	Area Treated (L/day)[b]	Dermal MOE[c]	Inhalation MOE	Combined MOE[d]
Residential fruit trees: Homeowner wearing a short-sleeved shirt, short pants, (PHED = chemical-resistant gloves, ORETF = no gloves) Target: 300							
Backpack	No backpack data was available for trees						
High-pressure handwand	PHED	Fruit trees (apple maggot)	0.6697	20	1400	135 000	**1400**
			0.5376		1750	168 000	**1740**
		Fruit trees	0.4464		2100	202 000	**2090**
		Grapes	0.5376		1750	168 000	**1740**
Handheld sprayer	ORETF	Fruit trees (apple maggot)	0.6697		370	3 000 000	**370**
			0.5376		465	4 000 000	**465**
		Fruit trees	0.4464		560	5 000 000	**560**
		Grapes	0.5376		465	4 000 000	**465**
Hose-end sprayer	ORETF	Fruit trees (apple maggot)	0.6697		385	6 000 000	**385**
			0.5376		480	7 000 000	**480**
		Fruit trees	0.4464		576	9 000 000	**576**
		Grapes	0.5376		480	7 000 000	**480**

[a] Median unit exposures are used from ORETF, best-fit unit exposures are used from PHED

[b] From USEPA SOPs for residential exposure assessments (Revised 22 February 2001); amount handled per day is 20 L for low-pressure handwand, backpack and hose-end sprayer. This value was also used for high pressure handwand, as there was no amount handled per day value in the SOPs.

[c] Based on an oral LOAEL of 3.9 mg/kg bw/day, target MOE is 300; dermal absorption = 50%

[d] Calculated using the following equation: combined MOE = 1/[1/dermal MOE + 1/inhalation MOE]

[e] These values underestimate the exposure to homeowners, as PHED applicator dermal unit exposure data include gloves.

Table 2 Adult and Youth Short-term Postapplication Exposure and Risk Assessments to Residential Fruit Trees After a Single Application[a]

Scenario		Transfer Coefficient (TC)[b] (cm^2/hr)	Duration (hr)	Dermal MOE[c] (day 0)[d] Target = 300	
				Low rate	High rate
Fruit trees: apple maggot				**(0.5376 g a.i./L)**	**(0.6697 g a.i./L)**
Adult (70 kg)	Harvesting	1500	0.67	**250**	**200**
	Thinning	3000		**125**	**100**
Youth (39 kg)	Harvesting	1040		**200**	**165**
	Thinning	2070		**100**	**80**
Grape: berry moth				**N/A**	**(0.5376 g a.i./L)**
Adult (70 kg)	Harvesting	5000	0.67	—	**75**
	Thinning	5000		—	**75**
Youth (39 kg)	Harvesting	3440		—	**61**
	Thinning	3440		—	**61**
All other pests				**N/A**	**(0.4464 g a.i./L)**
Adult (70 kg)	Harvesting	1500	0.67	—	**300**
	Thinning	3000		—	**150**
Youth (39 kg)	Harvesting	1040		—	**240**
	Thinning	2070		—	**120**

(Shading indicates calculated MOEs that are less than target MOEs)

[a] A single application greatly underestimates actual exposure, because label allows three applications per season and residues are expected to accumulate as phosalone dissipates slowly.

[b] Transfer coefficients are based on generic agricultural transfer coefficients for harvesting and thinning. TCs based on a body weight of 70 kg were scaled for the surface area of a 39 kg youth. (Correction factor 12 700 cm^2/18 440 cm^2 = 68.9%)

[c] Adult and youth short-term MOEs are based on a oral LOAEL of 3.9 mg/kg bw/day with a target MOE of 300 for all actives; dermal absorption = 50%

$$MOE = \frac{1/ [DFR \times TC \times duration \times DA]}{bw}$$

DFR studies submitted to the PMRA contained significant limitations; as such, they were used qualitatively rather then quantitatively. A peak default DFR value of 20% of the application rate was used, as it was comparable to peak residues in the submitted DFR studies. A dissipation rate of 3.5% per day was used, as it gave the desired half-life of 20 days, as determined qualitatively from the submitted DFR studies.

[d] Re-entry activities were assessed on day 0, not at the PHI, as REIs are considered to not be appropriate for domestic products.