Pest Management Regulatory Agency
Agence de réglementation de la lutte antiparasitaire

Proposed Acceptability for Continuing Registration

PACR2003-04

Re-evaluation of coumaphos

The purpose of this document is to inform the registrant, pesticide regulatory officials, and the Canadian public that the Pest Management Regulatory Agency (PMRA) has completed a re-evaluation of coumaphos pursuant to Section 19 of the Pest Control Products (PCP) Regulations. This Proposed Acceptability for Continuing Registration (PACR) document provides a summary of the data and information reviewed, and the rationale for the proposed regulatory decision.

By way of this document, the PMRA is soliciting comments from interested parties on the proposed regulatory decision for coumaphos. 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. All comments should be forwarded to the Publications Coordinator at the address below.

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Foreword

The re-evaluation of the active ingredient coumaphos and its associated end-use products, registered for use on food and non-food areas, has been completed by the Pest Management Regulatory Agency (PMRA). The registrant of the technical grade active ingredient (TGAI) is Bayer Inc. Chemicals Division.

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

Subsequent to that announcement, Bayer, registrant of the technical grade active ingredient and several end-use products, indicated that it intended to provide continued support for products containing coumaphos on cattle, swine and horses (non-food), but not on other livestock.

The PMRA has carried out an assessment of available information and has found it sufficient, pursuant to Section 20 of the PCP Regulations, to allow a determination of the safety, merit and value of coumaphos and associated end-use products used on horses (non-food), cattle and swine. The Agency has concluded that the use of coumaphos and its end-use products does not entail an unacceptable risk to human health and the environment pursuant to Section 20, provided that the proposed mitigation measures described in the document are implemented.

It is proposed that the Food and Drugs Regulations (FDR) be amended so that, with the exception of meat, meat by-products and fat of cattle and swine, food with quantifiable residues of coumaphos cannot be sold in Canada, unless additional data to support coumaphos residues in imported food are provided.

The PMRA will accept written comments on this proposal up to 60 days from the date of this document to allow interested parties an opportunity to provide input into the proposed re-evaluation decision for these products.

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[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 Pest Management Regulatory Agency's re-evaluation of the insecticide coumaphos and its end-use products. It includes a human health assessment, an environmental assessment and information on the value of coumaphos to pest management in Canada. By way of this document, the Agency is soliciting comments from interested parties on the decisions and mitigation measures proposed.

2.0 General background for re-evaluation

The PMRA is re-evaluating, under Section 19 of the Regulations pursuant to the *Pest Control Products Act* (PCPA), all pesticides, both active ingredients (a.i.) and formulated end-use products (EPs), that were registered prior to 1995. As outlined in Regulatory Directive DIR2001-03 *PMRA Re-evaluation Program*, a modern scientific approach is used to determine the continuing acceptability of older active ingredients in relation to human health and the environment. Coumaphos is under reassessment in the U.S. (United States of America) as a result of the *Food Quality Protection Act* and is therefore being re-evaluated by PMRA under Program 3. The following components are addressed and considered in this re-evaluation:

Risk to human health: The initial focus of the re-evaluation of a pest control product in Program 3 is the risk to human health. As indicated in Regulatory Directive DIR2001-03, the reassessment in Program 3 pays particular attention to:

- pest control products with a common mechanism of toxicity
- aggregate exposure to a pesticide arising from its residues in food and in drinking water, and from non-occupational exposure, such as from treatments in and around the home
- susceptibility and exposure of infants and children that may be different from that of adults during critical developmental stages.

The re-evaluation of risks to human health also includes a re-examination of the acceptability of risks resulting from occupational exposure. Once the reassessments of all the individual organophosphates have been completed, a cumulative assessment of all the remaining uses of organophosphates will be conducted.

Risk to the environment: The environmental assessments will be tiered, with refined environmental risk assessments taking place only on those actives, products or uses that pass the cumulative health risk assessment or, for unique mechanisms of toxicity, that are acceptable from a human health perspective. At the first tier, based on an identification of hazards to non-target organisms, measures to reduce environmental exposure will be implemented where warranted. These measures may include removing uses which are

obsolete, reducing the number of applications, requiring buffer zones to protect sensitive habitats, and taking regulatory action against uses that have been determined to be extremely high risk to organisms in the environment. In general, uses which remain after the first tier assessment will be revisited when the results of refined environmental assessments are available.

A tiered approach is necessary for several reasons. For some products, initial environmental assessments indicate a high hazard. However, there is considerable uncertainty with regard to the frequency and magnitude of exposure and effects. For some products there is also little data on field concentrations and (or) adverse effects. A tiered approach to environmental risk assessment would allow time for development and implementation of refined ecological risk assessment methods, for additional data to be provided to refine the environmental exposure assessments, and for consideration of the preferability of existing alternatives and the development of new ones. In addition, a tiered approach would make most efficient use of assessment resources.

Value: The PMRA seeks to understand, as early as possible in the re-evaluation process, the current uses of products under review and their importance for pest management in agriculture, the nursery trades, forestry and public health. The PMRA relies to a great extent on provincial and territorial government input. Registrants and users are also an important source of information. Environment Canada, the Department of Foreign Affairs and International Trade, the Canadian Food Inspection Agency (CFIA) and Agriculture and Agri-Food Canada, are also contacted during the re-evaluation process, as needed, for information specific to their areas of expertise.

The outcome of the re-evaluation of each pesticide, including proposed risk mitigation measures, will be published in a consultation document at the end of the aggregate human health risk assessment and the first tier environmental assessment. In some cases the PMRA will implement changes in regulatory status of products prior to public consultation, especially where the PMRA considers risk mitigation ineffective or impractical, or where registrants have opted for voluntary discontinuation of the sale of products.

3.0 Re-evaluation of coumaphos

Coumaphos is one of 27 organophosphate pesticides subject to re-evaluation in Canada. The re-evaluation of coumaphos was announced in Re-evaluation Document REV99-01 *Re-evaluation of Organophosphate Pesticides*. Coumaphos is a broad spectrum organophosphate insecticide which inhibits the enzyme acetylcholinesterase, interrupting the transmission of nerve impulses. It works by contact and ingestion, vapour action and systemic action. Coumaphos, also known by the Trademark “Co-Ral”, has been used in registered pest control products in Canada since 1958 when the Commercial Class product “Co-Ral Animal Insecticide 25% Wettable Powder” (Reg. No. 6857) was registered. The currently registered products containing coumaphos are listed in Appendix I.

Much of the scientific information used by the PMRA in its assessment of coumaphos came from reviews conducted by the United States Environmental Protection Agency (EPA). The EPA review of coumaphos can be referenced for further details regarding scientific studies used by the PMRA. These reviews, as well as other information on the regulatory status of coumaphos in the United States, can be found at the Web site of the Environmental Protection Agency http://www.epa.gov/ebtpages/pesticides.html.

3.1 Chemical identification

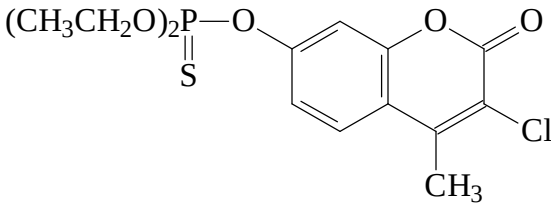
Chemical name
International Union of Pure and Applied Chemistry (IUPAC):
O-3-chloro-4-methyl-2-oxo-2H-chromen-7-yl O, O-diethyl phosphorothioate, or
3-chloro-7-diethoxyphosphinothioyloxy-4-methylcoumarin

or

Chemical Abstracts Service (CAS):
O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) O,O-diethyl phosphorothioate

Molecular formula: $C_{14}H_{16}ClO_5PS$

Structural formula:



3.2 Description of current registered uses

The following information is based on the currently registered uses of coumaphos.

3.2.1 Uses of coumaphos supported by the registrant

The following uses are supported by the registrant and considered in the re-evaluation assessment:

Livestock: dairy cattle, beef cattle, horses and swine.

In the U.S., coumaphos is registered for the same sites as in Canada, but with the addition of swine bedding.

Type of pesticide: insecticide.

Target pests:
Class Insecta
Diptera: horn fly, face fly, blow fly maggots
Anoplura: sucking lice
Mallophaga: chewing lice

Formulation types registered: dust, spray foam.

Method and rates of application:

Equipment—In agriculture, shaker can to cattle and swine; dust bag to cattle; foam spray to beef cattle and horses.

Method and rate—On cattle with a shaker can at 0.55 g a.i./animal applied up to twice a year with applications 10 days apart; application may be done on the day of slaughter.

On swine with a shaker can at 0.28 g a.i./animal applied twice a year with applications ten days apart. Applications may be made on the day of slaughter.

On cattle with dust bag (1% coumaphos), self-applied by animal when passing under the dust bag once a day; application may be made up to the day before slaughter; for lactating cows locate bag such that cattle are treated after milking.

On beef cattle as a spray foam (3% coumaphos), apply to wound and around wound as necessary at weekly intervals; pre-slaughter interval of 7 days.

On horses not to be slaughtered for food, as a spray foam (3% coumaphos), applied to wound and around wound as necessary at weekly intervals.

3.2.2 Uses of coumaphos not supported by the registrant

The following uses are not supported by the registrant:

- Livestock spray for the control of lice, ticks and cattle grubs on beef cattle and non-lactating dairy cattle
- Livestock spray for the control of lice and ticks on goats and sheep
- Livestock spray for the control of lice, northern fowl mite and roost mite on poultry (chickens, ducks, geese and turkey)
- Livestock spray and dip to control lice and ticks on swine
- Livestock spray and dip to control sarcoptic mites on swine.

4.0 Effects having relevance to human health

4.1 Toxicology summary

The toxicology database supporting coumaphos is based primarily on studies available from the registrant. In laboratory animals, coumaphos is highly acutely toxic via the oral route, moderately toxic by the inhalation route and of low toxicity by the dermal route of exposure. Toxic symptoms are largely caused by the inhibition of cholinesterase. With oral exposure, coumaphos was readily absorbed and rapidly eliminated with little tissue retention. Excretion occurred via the urine and to a lesser degree in the feces. The identified urinary metabolites were unchanged coumaphos and chlorferon.

Following both single and repeated dosing, the most sensitive indicator of toxicity was the inhibition of acetylcholinesterase, an enzyme necessary for the proper functioning of the nervous system. Acetylcholinesterase was affected by oral and dermal routes with no appreciable species differences. In the acute oral toxicity studies, female rats are approximately 17 times more sensitive to the toxic and lethal effects of coumaphos compared with male rats.

Although the database is limited, a comparison of the results of subchronic and chronic studies indicates that duration of dosing has little impact on toxicity. In chronic studies, the only systemic effect other than cholinergic toxicity was a slight decrease in body weight gain in male and female rats.

Coumaphos showed no evidence of tumorigenicity in either rats or mice following chronic dosing. However, the PMRA contends that a maximum tolerated dose (MTD) was not attained in the original study nor in the subsequent 8-week study in mice based on the lack of brain cholinesterase inhibition or any clinical signs of cholinergic toxicity. The rationale provided by Bayer's toxicologists on the adequacy of dosing in the mouse carcinogenicity study did not satisfy PMRA that an MTD had been reached in this study. Therefore, the PMRA's decision regarding the lack of an adequate mouse carcinogenicity study in the toxicology database for coumaphos is reflected in the assessment of the acceptable daily intake (ADI). Genotoxicity studies showed no significant response.

In acute and subchronic oral neurotoxicity studies in rats, no treatment-related neuropathology was evident, although cholinergic signs of toxicity were demonstrated. There was no evidence of neuropathology in the remainder of the database in rodents. There was no evidence of delayed-type neurotoxicity (OPIDN) with oral exposure in the hen in guideline toxicology studies conducted by the registrant. Neurotoxic esterase (NTE) was not measured in these studies. Information in the open literature indicates that coumaphos could cause delayed neurotoxicity in hens following both oral and dermal exposures.

The developmental toxicity studies in rats and rabbits showed no evidence of teratogenic effects and no additional sensitivity of the fetus following in utero exposure to coumaphos. In the 2-generation reproductive toxicity study in rats, no sensitivity of the young was demonstrated at the levels tested. Parental and offspring effects included depressed cholinesterase activity. No reproductive effects were observed.

Reference doses have been set based on no observed adverse effect levels (NOAELs) for the most sensitive indicator of toxicity, namely acetylcholinesterase inhibition. These reference doses incorporate various uncertainty factors (UF) to account for extrapolating between laboratory animals and humans and for variability within the human population. An additional safety factor (SF) has been used to provide an additional safeguard for the delayed neurotoxic potential of coumaphos. As this potential has been demonstrated in hens, it is considered prudent to include this safety factor when using rodent studies for risk assessment given that rodents are generally a less sensitive model for detecting delayed neurotoxicity. An additional safety factor has also been used for chronic exposure scenarios to account for the lack of an adequately conducted mouse carcinogenicity study.

The toxicology end points used in the risk assessment of coumaphos are summarized in Appendix II.

4.2 Occupational risk assessment

Occupational risk is estimated by comparing the potential exposure of persons mixing, loading and applying pesticides to the most relevant end points from toxicology studies to generate a Margin of Exposure (MOE). The risk exceeds the PMRA's level of concern if the MOE is less than the desired or target MOE.

For **short-term dermal exposure (1–7 days)**, the toxic end point selected is from a 5-day dermal toxicity study in female rats with a NOAEL of 5 mg/kg bw/d based on statistically significant inhibition of brain cholinesterase activity at 10 mg/kg (lowest observed adverse effect level—LOAEL). **A target MOE of 300** is required for short-term dermal occupational risk assessment and includes the conventional uncertainty factor of 100 (10× for interspecies extrapolation and 10× for intraspecies variability) as well as an additional safety factor of 3× for the end point of concern (delayed-type neurotoxicity).

For **short-term inhalation exposure**, there were no inhalation studies, so oral toxicity data were used as an alternative to inhalation data in route-to-route extrapolation.

For short-term inhalation risk assessment, the selected toxic end point is from a 13-week oral study in rats with a NOAEL of 0.2 mg/kg bw/d based on statistically significant inhibition of erythrocyte cholinesterase in both male and female rats at the LOAEL of 0.5 mg/kg bw/d. **A target MOE of 300** is required for short-term inhalation occupational risk assessment and includes the conventional 100× as well as an additional safety factor of 3× for the end point of concern (delayed-type neurotoxicity).

4.2.1 Mixer/loader/applicator exposure

For livestock application, workers can be exposed occupationally to coumaphos through loading, applying and handling the registered products during normal use. Applicators are expected to have short-term exposure. Based on the use pattern of coumaphos, 3 major exposure scenarios were identified: 1) applying dust with shaker can, 2) loading dust into livestock self-duster, and 3) applying spray foam from can. Dermal and inhalation exposure estimates for scenarios 2 and 3 are based on data from the Pesticide Handlers Exposure Database Version 1.1 (PHED). PHED is a compilation of generic mixer/loader/applicator passive dosimetry data with associated software which facilitates the generation of scenario-specific exposure estimates. To estimate exposure for each use scenario, appropriate subsets were created from the mixer, loader and applicator database files of PHED. All data were normalized for the amount, in kilograms, of active ingredient handled. Exposure estimates were calculated on the basis of the best-fit measure of central tendency, i.e., summing the measure of central tendency for each body part which is most appropriate to the distribution of data for that body part. As the PHED data are not specifically for animal treatments or for these specific scenarios, there is some uncertainty associated with the exposure estimates. However, the PHED exposure data provide a reasonable frame of reference to approximately assess the risks.

Exposure is calculated as the product of the unit exposure for a given scenario and the amount of active ingredient handled per day, divided by the body weight. Occupational risk is estimated by comparing a calculated MOE to a target MOE incorporating safety factors protective of the most sensitive subpopulation. For coumaphos, the adverse toxicological end point of cholinesterase inhibition is the same regardless of exposure route and the short-term risk assessments have the same target MOE of 300, thus it is appropriate to combine the route-specific MOEs into a single risk estimate. MOEs greater than or equal to 300 do not require risk mitigation.

MOEs for workers loading dust into dust bags (scenario 2) have MOEs greater than 300. Although these MOEs are acceptable, use of cotton coveralls, respirator and chemical resistant gloves is recommended as the PHED data used was for wettable powder and may underestimate exposure when dusts are used. MOEs for workers applying spray foam (scenario 3) are less than 300 and require the following mitigation: cotton coveralls, respirator, chemical resistant gloves and limitation of the amount of product an individual may use in one day to one can. A quantitative risk assessment for applying dust using a shaker can (scenario 1) was not conducted because there is no data available which represents this use pattern. In the absence of data, the following mitigation is required: cotton coveralls, respirator, chemical resistant gloves, and limiting the number of animals treated per day to 25.

4.2.2 Post-application exposure

After application is complete, contact with treated animals would probably not result in exposure greater than applicators would receive. Cattle and swine are not usually handled except for milking and the use pattern of these products prohibits treatment before milking. Although horses may require handling after treatment, they are only treated on wounds and the wounds are unlikely to be touched. Therefore no quantitative post-application exposure assessment was conducted. However, the product labels should instruct users not to enter treatment areas (livestock self-duster) or allow contact with treated animals until dusts have settled or spray foam has dried, and specify that dairy cows are not to be milked within 12 hours of treatment.

4.3 Residential risk assessment

Coumaphos is not registered for use in any residential areas, so a residential risk assessment was not required.

4.4 Dietary risk assessment

In a dietary exposure assessment, the PMRA determines how much of a pesticide residue, including residues in milk and meat, may be ingested as part of the daily diet. These dietary assessments are age-specific and incorporate the different eating habits of the population at various stages of life. For example, assessments take into account children's greater consumption of fruit, vegetables and juices for their body weight compared with adults.

Acute dietary risk is calculated by considering food consumption and residue values in food. A probabilistic statistical analysis allows all possible combinations of consumption and residue levels to be combined to estimate a distribution of the amount of coumaphos residue which might be eaten in a day. A 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 expected intake from residues is less than the ARfD, the expected intake is not considered to be of concern.

The chronic dietary risk is 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 to the ADI, which is the dose at which an individual could be exposed over the course of 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 acute dietary risk (1 day), the **LOAEL of 2.0 mg/kg bw** from the acute neurotoxicity study in rats is selected for risk assessment. This LOAEL is established based on plasma cholinesterase inhibition in females and erythrocyte cholinesterase

inhibition in both male and female rats. An overall **safety factor of 1000** is required to account for interspecies extrapolation (10×) and intraspecies variability (10×), as well as an additional 3× uncertainty factor, which is warranted due to the lack of a NOAEL in this study and an additional safety factor of 3× to account for the delayed neurotoxic potential of coumaphos. The ARfD was calculated to be 0.002 mg/kg bw (2.0 mg/kg bw ÷1000). This value was considered to be protective of all populations including infants and children.

To estimate dietary risk from the repeat or chronic exposure, the NOAEL of 0.3 mg/kg bw/d from the 2-generation reproduction study is selected for risk assessment. The NOAEL is based on inhibition of brain cholinesterase in males and females (parents and offspring) at the LOAEL of 1.79 mg/kg bw/d. This NOAEL also addresses the NOAEL of 0.36 mg/kg bw/d from the 2-year rat chronic/carcinogenicity study. Standard uncertainty factors of 10× for interspecies extrapolation and 10× for intraspecies variability are used. No additional safety factor for sensitivity of young is required. An additional 10× safety factor is used to account for the end point of concern (delayed-type neurotoxicity) and for the lack of an adequately conducted mouse carcinogenicity study. The ADI was calculated to be 0.0003 mg/kg bw/d (0.3 mg/kg bw/d ÷ 1000). This value was considered to be protective of all populations including infants and children.

4.4.1 Dietary exposure

The Canadian Food and Drug Regulations (FDR) Div 15, Table II, defines coumaphos as the residue of concern (ROC). It is recommended that, based on EPA and FAO/WHO reviews, the ROC be updated to include coumaphoxon.

Acute and chronic dietary exposure and risk estimates were generated using the Dietary Exposure Evaluation Model (DEEM®) software and updated consumption data from the FDA's Continuing Survey of Food Intake of Individuals, CSFII (1994–1998).

The acute dietary exposure was assessed using a refined assessment. Refinements for commodities on which coumaphos is registered in the U.S. and in Canada included the following, where appropriate: generating residue distribution files (RDFs) which incorporate upper bound anticipated residues (coumaphos + coumaphoxon), FDA monitoring data, and percent livestock treated (%LT) estimates. It was also assumed that the recommended label improvements were followed. The acute potential daily intake (PDI) accounted for < 79% (99.9th percentile) of the acute reference dose (ARfD) for all sub-populations, with children 1–6 years old being the most highly exposed sub-population.

The chronic dietary exposure was assessed using a refined assessment. Refinements for commodities on which coumaphos is registered in the U.S. and in Canada included the following, where appropriate: incorporating average anticipated residues (coumaphos + coumaphoxon), FDA monitoring data, and %LT estimates. It was also assumed that the recommended label improvements were followed. The chronic PDI accounted for < 11%

of the acceptable daily intake (ADI) for all sub-populations, with children 1–6 years old being the most highly exposed sub-population.

These chronic and acute dietary risk assessments demonstrated that there were no health concerns for any population subgroup in Canada, including infants, children, teenagers, adults and seniors. In addition, no health concerns were evident for nursing or pregnant females or based on gender in general.

4.5 Aggregate risk assessment

There are no residential uses of coumaphos and no residues are expected to occur in drinking water, so an aggregate risk assessment was not conducted.

5.0 Environmental assessment

5.1 Environmental fate

This assessment is based on the data from the U.S. EPA re-registration eligibility decision (RED) of coumaphos (Environmental Fate and Effects Division (EFED) RED chapter for coumaphos, Aug, 1996).

The vapour pressure for coumaphos was determined to be 1.3×10^{-05} Pa (9.75×10^{-08} mm Hg), which indicates that coumaphos has a low potential to volatilize. The calculated Henry's Law Constant ($K = 2.98 \times 10^{-08}$ atm m^3/mole) indicated that coumaphos is unlikely to volatilize from moist soil or water surfaces.

The available environmental fate studies indicate that coumaphos is persistent in the environment. The half-life for hydrolysis is greater than 30 days (d) and the laboratory biotransformation DT_{50} is greater than a year. In addition, a DT_{50} ranging between approximately 118 and 185 d was determined in the terrestrial field dissipation study. A phototransformation study was not available for soil. Phototransformation will play an important role in the dissipation of coumaphos from surface waters ($t_{½}$ = 33 h). The major transformation products identified in one or more of the laboratory studies include chlorferon, coumaphoxon, 6-hydroxyl-3-methylbenzofuran and O,O-diethyl-O-(3-acetoxy) phenylphosphorothioate. Little information is available regarding the persistence of these transformation products in the environment.

Adsorption studies indicate that coumaphos is immobile (K_d = 61–298) and thus, is unlikely to leach in groundwater. Adsorption coefficients were also determined for chlorferon (K_d = 91–191) and is also classified as immobile. A leaching study indicated that coumaphos is immobile as it accounted for only 0.4% of the leachate from a sandy loam column and less than 2% of the leachate from columns of sand, silt loam, and silty clay loam.

The log octanol-water partition coefficient ranges from 3.86 to 4.06 and indicates a potential for bioaccumulation. A laboratory bioaccumulation study had been conducted but was considered invalid.

5.2 Environmental toxicology

Coumaphos is highly to very highly toxic to wild birds on an acute basis (LD_{50} = 29.8–2.4 mg a.i./kg bw). The acute avian dietary studies indicate that coumaphos ranges from moderately to highly toxic (LC_{50} = 709–82.1 mg a.i./kg diet). The limited available toxicity data for mammals indicate that coumaphos is highly toxic to mammals (LD_{50} = 14 mg a.i./kg bw). Based on cholinesterase inhibition in a rat reproductive study, the no observed effect level (NOEL) was determined to be 1 mg a.i./kg diet.

On an acute basis, coumaphos is classified as moderately to very highly toxic to aquatic organisms. The acute toxicity LC_{50} ranges from 0.074 µg a.i./L to 0.224 µg a.i./L for freshwater invertebrates. Similar results were obtained for estuarine and marine invertebrates. The no observed effect concentration (NOEC) determined for *Daphnia magna* during a life-cycle study was 0.0337 µg a.i./L. The LC_{50} for freshwater fish ranges from 5900 µg a.i./L for rainbow trout to 340 µg a.i./L for the bluegill sunfish. The LC_{50} determined for estuarine and marine fish was determined to be 280 µg a.i./L for the sheepshead minnow.

5.3 Concentrations in drinking water

The impact of coumaphos on drinking water is expected to be limited. The total amount used in Canada is small and the application method is not likely to result in the active ingredient reaching the soil unless a spill of the product occurs.

5.4 Terrestrial assessment

There is evidence, in a study submitted to the U.S. EPA, that birds will be exposed to coumaphos which is applied to cattle. The exposure may occur by direct contact with treated cattle, exposure to cattle hair, and (or) by exposure to contaminated soil and feed in and around treatment areas. In this study, 34 species were observed within 200 m of the treatment site with six species observed on the ground within the pen. In addition, coumaphos was detected in the stomach contents of cowbirds.

There is no acceptable method for quantifying exposure to birds from application of a pesticide to livestock. Birds may be subject to primary exposure (ingestion of hair and skin debris or contaminated invertebrates from treated cattle) or secondary exposure (scavenging activity). Dermal contact with coumaphos can result in coumaphos toxicity through dermal adsorption. In addition, coumaphos can be ingested by birds by preening feathers that were contaminated with coumaphos resulting from dermal contact with freshly treated animals.

The U.S. EPA has one report of an incident in which a bald eagle was found dead as a result of coumaphos poisoning. The exact mechanism for the exposure was unknown.

5.5 Aquatic assessment

Although the PMRA has limited information on the degree to which aquatic invertebrates will be exposed to coumaphos, environmental exposure is expected to be limited as use of coumaphos is restricted to treatment of livestock.

5.6 Toxic Substances Management Policy statement

During the review of coumaphos, the PMRA has taken into account the federal Toxic Substances Management Policy[2](TSMP) and has followed its Regulatory Directive DIR99-03[3]. The following were considered:

- Coumaphos has the potential to bioaccumulate, however the log octanol-water partition coefficient (log K_{ow}) is 4.05, which is below the TSMP Track-1 cut-off criterion of log $K_{ow} \geq 5.0$.

- Coumaphos meets the criteria for persistence as the measured DT_{50} (185 d– > 1 yr) value in soil meets the TSMP Track-1 cut-off criteria of ≥ 182 days. Insufficient data were available to assess the persistence of coumaphos in water or sediment although it is not expected to persist in water where sunlight can penetrate (photic zone) ($t_{½}$ = 33 h). The K_d of coumaphos indicates that it is likely to adsorb to suspended particles and sediment. The persistence of coumaphos in sediment is expected to be similar to that of coumaphos in soil.

- The toxicity of coumaphos is described in Sections 4 and 5.2.

- No data were available to assess the major transformation products, O,O-diethyl-O-(3-acetoxy) phenylphosphorothioate; coumaphoxon; 6-hydroxy-3-methylbenzofuran and chlorferon, according to the TSMP directive.

- The technical does not contain any microcontaminants with TSMP Track-1 implications.

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2 The federal Toxic Substances Management Policy is available through Environment Canada's Web site at: http://www.ec.gc.ca/toxics.

3 Regulatory Directive DIR99-03, is available through the Pest Management Information Service: Phone 1-800-267-6315 within Canada or 1-613-736-3799 outside Canada (long distance charges apply); Fax (613) 736-3798; E-Mail pminfoserv@hc-sc.gc.ca or through our Web site at http://www.hc-sc.gc.ca/pmra-arla.

It has been determined that coumaphos does not meet TSMP Track-1 criteria because it does not meet the criterion for bioaccumulation.

5.7 Formulants in pest control products

Formulant issues are being addressed through 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 will be subject to future regulatory action as outlined in the formulant policy, soon to be issued as a regulatory directive (see PRO2000-04 *Formulants Policy*).

5.8 Environmental Assessment Conclusions

Although acceptable methods for conducting a quantitative environmental assessment were not in place, the evidence suggests that there is a potential risk to wild birds and aquatic organisms from the use of coumaphos as a livestock pesticide. Coumaphos is highly toxic to both birds and aquatic invertebrates and so, if these non-target organisms are exposed to it, non-target effects are likely to occur. Although the PMRA has limited information on the degree to which wild birds and aquatic invertebrates will be exposed to coumaphos, environmental exposure is expected to be limited as use of coumaphos is restricted to treatment of livestock. General label statements regarding environmental toxicity are required (see Section 7.2).

6.0 Value

6.1 Evaluation method

The importance of coumaphos end-use products for managing specific pests on specific crops in Canada was evaluated based on:

- the availability of registered alternative pesticides that are potential substitutes

- current field use of coumaphos in agriculture in Canada as assessed by a survey of organophosphate (OP) use conducted in 1998 (the “1998 OP Survey”) with the cooperation of provincial governments, and from consultations with crop production specialists

- expert opinion of provincial agricultural officials, grower groups, and other stakeholders.

Uses of coumaphos were divided into four value classes as follows:

Key uses:
Based on the results from the 1998 OP Survey and the availability of effective registered alternative pesticides, some uses of coumaphos were considered "key uses" because they matched one or more of the following criteria:

- a User Requested Minor Use Label Expansion (URMULE) was granted after the 1998 OP Survey and there are no registered alternatives, OR
- there was reported use of at least 10% and there are no registered alternatives, OR
- there was reported use of at least 10% and the alternatives are other organophosphate (OP) insecticides and coumaphos is the preferred active, OR
- maintaining registration was considered key for resistance management and (or) plays an important role in IPM programs, OR
- the site of use is of large importance to the economy of Canada.

Important uses:
Based on the 1998 OP Survey, some uses of coumaphos were considered "important uses" because they matched the following criteria:

- at least 10% of the given site has been reported to receive treatment with coumaphos in some provinces, AND
- non-OP alternatives to coumaphos are registered for each of these uses, however, coumaphos was reported to be either the primary pest control product for that use, or one of the preferred products for that use.

Other reported uses:
Based on the 1998 OP Survey, some uses of coumaphos were considered "other reported uses" because they matched one of the following criteria:

- greater than 5% of the given site was treated in some provinces, non-OP alternatives to coumaphos are registered for each of these uses, and the alternatives were reported to be used to treat a greater percentage of crop/site than coumaphos, OR

- less than 5% of the given crop was treated or there was no reported use but there was an URMULE for the pest issued after the 1998 OP Survey and there are registered non-OP alternatives.

Little or no reported use:
Based on the 1998 OP Survey, some uses of coumaphos were considered to have "little or no reported use" because they matched one of the following criteria:

- less than 5% of the site in any province was reported to be treated with coumaphos, OR

- coumaphos is registered for use on certain sites for which the PMRA has received no information regarding the extent of use in the 1998 OP Survey.

6.2 Evaluation results

Key uses
- cattle (beef): for control of blow fly larvae (no registered pesticide alternatives in Canada)

- horses: for control of blow fly larvae (no registered pesticide alternatives in Canada).

Important uses
- cattle: for control of lice (a preferred active ingredient due to its low cost)

- cattle: for control of horn flies (a preferred active ingredient due to its low cost)

- cattle: for reduction of face flies (a preferred active ingredient due to its low cost).

Little or no reported use
- swine: for control of lice (less than 5% of the site in any province was reported to be treated with coumaphos).

7.0 Proposed regulatory action

The PMRA has determined that the aggregate risks for coumaphos are acceptable provided that the mitigation measures proposed below are adopted. The acceptable uses for coumaphos products, together with proposed mitigation measures and use limitations, are presented in Appendix III.

7.1 Proposed regulatory action relating to human health

1. Labels of pesticide products carry statements regarding symptoms of poisoning and treatment, which are especially important for those who may be overexposed

when working with the product in a commercial or industrial setting eg. mixers or loaders who handle the more concentrated forms. Based on the toxicological assessments, the label text of the coumaphos containing products should be expanded and (or) standardized, as follows:

"Toxicological Information:

Coumaphos is a cholinesterase inhibitor. Typical symptoms of overexposure to cholinesterase inhibitors include headache, nausea, dizziness, sweating, salivation, runny nose and eyes. This may progress to muscle twitching, weakness, tremor, incoordination, vomiting, abdominal cramps and diarrhea in more serious poisonings. A life-threatening poisoning is signified by loss of consciousness, incontinence, convulsions and respiratory depression with a secondary cardiovascular component. Treat symptomatically. If exposed, plasma and red blood cell cholinesterase tests may indicate degree of exposure (baseline data are useful). Atropine, only by injection, is the preferable antidote. Oximes, such as Pralidoxime Chloride, may be therapeutic if used early; however, use only in conjunction with atropine. In cases of severe acute poisoning, use antidotes immediately after establishing an open airway and respiration. With oral exposure, the decision of whether to induce vomiting or not should be made by an attending physician."

2. For those products which contain more than 10% petroleum distillates, the following text should also be added to Toxicological Information section (placed at the end of the paragraph presented above), as an additional aid to the attending physician:

"**NOTE:** Product contains a petroleum distillate solvent."

3. Label requirements:
   - A. Measures to protect applicators
     - i. All dust products:
       - wear NIOSH-approved dust/mist respirator, cotton coveralls over long pants, long sleeved shirt, shoes and socks, and chemical resistant gloves
     - ii. Dust in shaker can:
       - limit the number of animals an individual may treat to 25 per day
     - iii. Spray foam in a can:
       - wear NIOSH-approved dust/mist respirator, cotton coveralls over long pants, long sleeved shirt, shoes and socks, and chemical resistant gloves
       - limit the amount of product an individual may use in one day to one can

B. Measures to protect workers (all products)

- do not enter treatment areas or allow contact with treated animals until dust has settled or spray foam has dried
- do not milk cows within 12 hours of treatment

C. Measures pertaining to the dietary risk assessment (dust in shaker can)

- limit the number of applications to a maximum of two per season.

4. Coumaphos maximum residue limits (MRLs)

In general, when the re-evaluation of a pesticide has been completed, the PMRA intends to protect the food supply from continued use of the pesticide by recommending new residue limits at the limit of quantification for any agricultural commodities not approved for continued treatment in Canada, unless sufficient data are provided to support specific MRLs for import purposes. The implementation date of lowered MRLs will take into consideration the last date of legal use of products in Canada and the expected time for treated commodities to clear the channels of trade, usually one year. In the future, proposed amendments to the Food and Drugs Regulations reflecting these MRLs will be published in the Canada Gazette. The U.S. EPA undertakes similar action in such circumstances.

Currently, meat, meat by-products, and fat of cattle and various other livestock may contain residues of up to 0.5 ppm coumaphos; residues of coumaphos in other commodities must fall below 0.1 ppm, a default value specified by the Food and Drugs Regulations subsection B.15.002(1).

As a result of this re-evaluation of coumaphos, the PMRA will recommend the following:

- that the residue of concern be redefined to include coumaphos and coumaphoxon
- the retention of the current MRL of 0.5 ppm coumaphos for meat, meat by-products, and fat of cattle and swine
- the specification of an MRL of 0.01 ppm coumaphos and coumaphoxon for milk
- the specification of new MRLs at the limits of quantification (i.e., 0.05 ppm for other meat, meat by-products, and animal fat; 0.01 ppm for all other agricultural produce).

Parties interested in supporting an MRL to allow imports of other commodities treated with coumaphos should contact the PMRA during the consultation period to discuss the submission of appropriate data.

7.2 Proposed regulatory action relating to environment

A potential hazard to wild birds exists, but it is difficult to mitigate this hazard short of scaring away birds that may frequent areas where coumaphos is applied. In addition, a potential hazard to aquatic organisms was identified. General label statements regarding environmental toxicity are required. The following wording is suggested:

- This pesticide is toxic to birds, fish and aquatic invertebrates. Do not apply directly to any body of water. Do not contaminate water when disposing of used containers.

The following label statements will reduce the risk associated with aquatic exposure to coumaphos.

- Do not use this product near lakes, streams, ponds, or other aquatic systems.

- This product should not be applied when rain is forecast in order to reduce run-off from the treatment site.

Disposal: Dispose of used containers in accordance with provincial requirements. For information on disposal of unused, unwanted product, contact the manufacturer or the provincial regulatory agency. Contact the manufacturer and the provincial regulatory agency in case of a spill, and for clean-up of spills.

8.0 Additional data requirement

Scientifically based rationales for data waivers may also be acceptable for some of the following data requirements.

8.1 Chemistry

Data are required to confirm whether other microcontaminants such as O,S-TEPP, O,O-TEPP and the oxon form of coumaphos were analysed for or detected in the TGAI.

8.2 Toxicology

The following confirmatory data would be required to support the continued registration of coumaphos and to support any expansion of coumaphos use:

- a mouse carcinogenicity study should be repeated with adequate dose levels (DACO 4.4.2)

- delayed neurotoxicity studies by the oral and dermal routes that include an assessment of neurotoxic esterase (NTE) activity (DACO 4.5.10)

- a developmental neurotoxicity study (DACO 4.5.12)

8.3 Exposure

The following confirmatory data would be required to support the continued registration of coumaphos and to support any expansion of coumaphos use:

- Livestock metabolism studies or U.S. EPA Data Evaluation Records (DERs) are required to update the definition of the ROC to include coumaphoxon.

- Storage stability studies or U.S. EPA DERs are required for frozen beef and swine tissues.

Although not critical to the current coumaphos re-evaluation, the following data gaps were identified and may be required to support any expansion of coumaphos use:

- Livestock Spraying Practices Survey (1996) conducted by Bayer.

8.4 Data requirements relating to environmental risks

Even though the environmental fate database is limited, additional fate data on the active ingredient are not required for livestock uses of coumaphos at this time given the limited environmental exposure expected in the terrestrial and aquatic environments. If the use of coumaphos is to be expanded, the data requirements will be reviewed and additional data requirements may be identified at that time.

To complete the review of the livestock uses, K_{ow} values are required for the following transformation products:

- O,O-diethyl-O-(3-acetoxy) phenylphosphorothioate
- coumaphoxon
- 6-hydroxy-3-methylbenzofuran
- chlorferon

9.0 Proposed re-evaluation decision

The PMRA has carried out an assessment of available information and has concluded that the use of coumaphos and associated end-use products on cattle, swine and horses does not entail an unacceptable risk of harm to human health or the environment pursuant to Section 20, provided that the proposed mitigation measures described in the document are implemented. Further measures may be necessary or proposed pending the outcome of the cumulative risk assessment for all organophosphates, which share a common mechanism of toxicity, and pending refinements to environmental risk assessment methodologies.

It is proposed that the Food and Drugs Regulations (FDR) be amended so that, with the exception of meat, meat by-products and fat of cattle and swine, food with residues of coumaphos cannot be sold in Canada, unless additional data to support coumaphos residues in imported food are provided.

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 re-evaluation decision for these products.

List of abbreviations

ADI	Acceptable Daily Intake
a.i.	Active Ingredient
ARfD	Acute Reference Dose
atm	Atmospheres
bw	Body Weight
CAS	Chemical Abstracts Society
CEC	Cation exchange capacity
CSFII	Continuing Survey of Food Intake of Individuals
CI	Confidence Interval
cm	centimetre(s)
cm^3	centimetres cubed
d	day(s)
DEEM®	Dietary Exposure Evaluation Model
DER	Data Evaluation Record
DT_{50}	Dissipation Time to 50%
DT_{90}	Dissipation Time to 90%
EC_{10}	Effective Concentration to 10%
EC_{50}	Effective Concentration to 50%
EEC	Expected Environmental Concentration
EFED	Environmental Fate and Effects Division (U.S. EPA)
EP	End-Use Product
EPA	Environmental Protection Agency
FAO/WHO	Food and Agricultural Organization of the United Nations/World Health Organization
FDA	Food and Drug Administration (U.S.)
FDR	Canadian Food and Drug Regulations
g	Gram(s)
GC	Gas Chromatograph
GC/MSD	Gas Chromatography Mass Selective Detector
GLP	Good Laboratory Practice
h	hour(s)
ha	hectare
HPLC	High Performance Liquid Chromatography
K_d	Adsorption Coefficient
Kg	Kilogram(s)
K_{oc}	Organic carbon partition coefficient
K_{ow}	Octanol-water partition coefficient
LC_{50}	Lethal Concentration to 50%
LD_{50}	Lethal Dose to 50%
L	Litre
LOAEC	lowest observed adverse effect concentration [mg a.i./kg diet or mg a.i./L]
LOAEL	lowest observed adverse effect level [mg a.i./kg bw]
LOEC	lowest observed effect concentration [mg a.i./kg diet or mg a.i./L]
LOEL	lowest observed dose level [mg a.i./kg bw]

LOD	limit of detection
m^3	squared metre(s)
min	Minute(s)
mg	milligram
mm	Millimetre(s)
mm Hg	Millimetre mercury
mL	Millilitre
MOE	Margin of Exposure
mol	moles
MTD	Maximum Tolerated Dose
NIOSH	National Institute of Occupational Safety and Health
NOAEL	no observed adverse effect concentration
NOEC	no observed effect concentration
NOEL	no observed effect level
nm	nanometre
NTE	Neurotoxic esterase
OP	organophosphate insecticide
OPIDN	Organophosphorus Induced Delayed Neuropathy
PDI	Potential Daily intake
pH	-log10 hydrogen ion concentration
PHED	Pesticide Handlers Exposure Database
pKa	-log10 acid dissociation constant
PMRA	Pest Management Regulatory Agency
ppm	Parts per million
Reg. No.	*Pest Control Products Act* Registration Number
RDF	Residue Distribution File
ROC	Residue(s) of Concern
$t_{1/2}$	first-order half-life
TGAI	Technical Grade Active Ingredient
TLC	Thin Layer Chromatography
TSMP	Toxic Substance Management Policy
URMULE	User Requested Minor Use Label Expansion
U.S. EPA	United States Environmental Protection Agency
µg	Microgram
vp	Vapour Pressure
wk	week(s)

Appendix I Coumaphos products currently registered:

Registrant	Registration Number	Guarantee	Product Name	Class
Bayer	26474	98.5%	Bayer Coumaphos Technical Insecticide Dust	Technical
Bayer	6857	25%	Co-Ral Animal Insecticide 25% Wettable Powder	Commercial
Bayer	13466	1%	Co-Ral Animal Insecticide 1% Shaker Can	Commercial
Bayer	15103	3%	K.R.S. Spray Foam with Co-Ral	Commercial
United Agri Products	16772	1%	Clean Crop Cattle Dust Bags	Commercial

Appendix II Toxicology end points for health risk assessment for coumaphos

Exposure Scenario	Dose (Mg/kg Bw/d)	End Point	Study	Uf/sf or Moe[b]
Acute Dietary	LOAEL = 2.0	Erythrocyte cholinesterase inhibition	Acute Neurotoxicity —Rat	1000
	ARfD = 0.002 mg/kg bw			
Chronic Dietary	NOAEL = 0.3	Brain cholinesterase inhibition	2-Generation Reproduction Study—Rat	1000
	ADI = 0.0003 mg/kg bw/d			
Short-Term[a] Dermal	Dermal NOAEL = 5.0	Brain cholinesterase inhibition	5-Day Dermal Toxicity—female Rat	300
Short-Term[a] Inhalation[c]	Oral NOAEL = 0.2	Erythrocyte cholinesterase inhibition	13-Week Oral Toxicity—Rat	300

[a] Duration of exposure is 1–7 days
[b] 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.
[c] Since an oral NOAEL was selected, an inhalation absorption factor of 100% (default value) should be used in route-to-route extrapolation.

Appendix III Use standard for commercial class products containing coumaphos

(NOTE: The information in this appendix summarizes the acceptable uses, limitations and precautions for commercial class products containing coumaphos, but does not identify all label requirements for such products. Registrants are referred to the PMRA Registration Handbook for further guidance on label requirements for pest control products.)

COMMON NAME: coumaphos

CHEMICAL NAME: *O*,3-Cholo-4-methylcoumarin-7-yl-*O*,*O* diethyl phosphorothionate

FORMULATION TYPE:

DU	dust
PP	pressurized product (foam)

SITE CATEGORIES:

Livestock for food	08
Livestock, non-food	09

GENERAL LIMITATIONS:

Do not treat animals less than 3 months old or sick, convalescent or stressed livestock.
Do not treat non-lactating dairy animals within 14 days of freshening. If freshening should occur within 14 days of treatment, do not use milk as human food for the balance of the 14-day interval.
Do not apply in conjunction with oral drenches or other internal medications, or with natural or synthetic pyrethroids or their synergists.
Treat dairy cattle only after milking or 12 hours before milking.

TOXICOLOGICAL INFORMATION: Coumaphos is a cholinesterase inhibitor. Typical symptoms of overexposure to cholinesterase inhibitors include headache, nausea, dizziness, sweating, salivation, runny nose and eyes. This may progress to muscle twitching, weakness, tremor, incoordination, vomiting, abdominal cramps and diarrhea in more serious poisonings. A life-threatening poisoning is signified by loss of consciousness, incontinence, convulsions and respiratory depression with a secondary cardiovascular component. Treat symptomatically. If exposed, plasma and red blood cell cholinesterase tests may indicate degree of exposure (baseline data are useful). Atropine, only by injection, is the preferable antidote. Oximes, such as Pralidoxime Chloride, may be therapeutic if used early; however, use only in conjunction with atropine. In cases of severe acute poisoning, use antidotes immediately after establishing an open airway and respiration. With oral exposure, the decision of whether to induce vomiting or not should be made by an attending physician.

[For those products which contain more than 10% petroleum distillates, the following text should also be added to TOXICOLOGICAL INFORMATION section (placed at the end of the paragraph presented above), as an additional aid to the attending physician:

NOTE: Product contains a petroleum distillate solvent.]

PROTECTIVE CLOTHING AND EQUIPMENT:

Dust formulation in shaker can:

- All applicators and other handlers must wear a NIOSH-approved dust/mist respirator, cotton coveralls over long pants and a long-sleeved shirt, shoes, socks, and chemical resistant gloves.

Spray foam formulation:

- All applicators and other handlers must wear a NIOSH-approved dust/mist respirator, cotton coveralls over long pants and a long-sleeved shirt, shoes, socks, and chemical resistant gloves.

Dust formulation in livestock self-duster:

- All applicators and other handlers must wear a NIOSH-approved dust/mist respirator, cotton coveralls over long pants and a long-sleeved shirt, shoes, socks, and chemical resistant gloves.

ENVIRONMENTAL HAZARD AND PRECAUTIONS:

This pesticide is toxic to birds, fish and aquatic invertebrates.
Do not apply directly to any body of water.
Do not use this product near lakes, streams, ponds, or other aquatic systems.
This product should not be applied when rain is forecast in order to reduce run-off from the treatment site.

ACCEPTABLE USES FOR COUMAPHOS:

Section 1. Livestock for food
Section 2. Livestock, non-food

SITES, PESTS	RATES (AS ACTIVE) AND DIRECTIONS
1. LIVESTOCK FOR FOOD	
BEEF CATTLE, DAIRY CATTLE	
Horn fly, lice	Dust formulation: Up to 0.55 g (from 1% dust)/head Dust evenly into the air over the head, neck, shoulders, back and tail head. No interval is required between treatment and slaughter of beef cattle. For lice: If another treatment is necessary, do not treat within 10 days of the original application. Limitations: Do not treat more than 25 animals per day per person. Do not milk cows within 12 hours of treatment. Do not enter treated areas or come into contact with animals until dusts have settled. Do not apply more than two times per season.
Horn fly, face fly (reduction)	Livestock self-duster (dust 1%): Suspend duster in areas frequented by cattle or in gateways or lanes through which the animals pass daily. For lactating dairy cows, the duster should be suspended in a gateway or lane through which the cattle pass when leaving the milking barn. May be applied up to the day before slaughter. Limitations: Do not hang dust over feed, mineral or water troughs. Do not use inside barns, milking rooms or in the entrance doorway. Do not milk cows within 12 hours of treatment. Do not enter treated areas or come into contact with animals until dusts have settled.
Fly maggots (in wounds) Beef cattle only	Wound dressing (spray foam, 3%): Spray wounds for complete coverage. Repeat as necessary, but not more often than weekly. For prevention, spray a protective coating on new wounds from dehorning, castration, docking, injury, etc, as soon as possible to avoid infection. Repeat as necessary, but not more often than weekly. Limitations: Do not apply in conjunction with oral drenching or other internal medication, or with natural or synthetic pyrethroids or their synergists. Do not apply to cattle within 7 days of slaughter. Do not use more than one can per day per person. Do not come into contact with animals until spray foam has dried.

SITES, PESTS	RATES (AS ACTIVE) AND DIRECTIONS
SWINE	
Lice	Dust formulation: Up to 0.28 g (from 1% dust)/head Apply as a uniform coat to the shoulders and back. No interval is required between treatment and slaughter of swine. If another treatment is necessary, do not treat within 10 days of the original application. Limitations: Do not treat more than 25 animals per day per person. Do not enter treated areas or come into contact with animals until dust has settled. Do not apply more than twice per season.

2. LIVESTOCK, NON FOOD

HORSES	
Fly maggots (in wounds)	Wound dressing (spray foam 3%): Spray wounds for complete coverage. Repeat as necessary, but no more often than weekly. For prevention, spray a protective coating on new wounds from injury as soon as possible to avoid infection. Repeat as necessary but not more often than weekly. Limitations: Do not apply to horses that are to be slaughtered for food. Do not apply in conjunction with oral drenching or other internal medication, nor with natural or synthetic pyrethroids or their synergists. Do not apply more than one can per day per person. Do not come into contact with animals until spray foam has dried.