Environment Canada Environnement Canada

National Agri-Environmental Standards Initiative (NAESI)

Report No. 4-22

Environmental Risk-Based Standards for Pesticide Use in Canada: Supporting Tables for the Synthesis Report and Proof of Concept

Technical Series 2008

Photos:
Bottom Left- clockwise

Fraser Valley near Abbotsford, B.C.: Wayne Belzer, Pacific Yukon Region, Environment Canada
Crop spraying: Corel CD photo # 95C2840
Elk Creek, BC: Joseph Culp, National Water Research Institute, Environment Canada
Prairie smoke and bee: Emily Wallace, Prairie Northern Region, Environment Canada

This report can be cited as follows:

Mineau, P., T. Dawson, M. Whiteside, C. Morrison, K. Harding, L. Singh, T. Längle, and D.A.R. McQueen. 2008. Environmental Risk-Based Standards for Pesticide Use in Canada: Supporting Tables for the Synthesis Report and Proof of Concept. National Agri-Environmental Standards Initiative Technical Series Report No. 4-22. 151 p.

Prepared and published by
Environment Canada
Gatineau, QC

March 2008

NATIONAL AGRI-ENVIRONMENTAL STANDARDS INITIATIVE TECHNICAL SERIES

ENVIRONMENTAL RISK-BASED STANDARDS FOR PESTICIDE USE IN CANADA: SUPPORTING TABLES FOR THE SYNTHESIS REPORT AND PROOF OF CONCEPT

REPORT NO. 4-22

NOTE TO READERS

The National Agri-Environmental Standards Initiative (NAESI) is a four-year (2004-2008) project between Environment Canada (EC) and Agriculture and Agri-Food Canada (AAFC) and is one of many initiatives under AAFC's Agriculture Policy Framework (APF). The goals of the National Agri-Environmental Standards Initiative include:

- Establishing non-regulatory national environmental performance standards (with regional application) that support common EC and AAFC goals for the environment
- Evaluating standards attainable by environmentally-beneficial agricultural production and management practices; and
- Increasing understanding of relationships between agriculture and the environment.

Under NAESI, agri-environmental performance standards (i.e., outcome-based standards) will be established that identify both desired levels of environmental condition and levels considered achievable based on available technology and practice. These standards will be integrated by AAFC into beneficial agricultural management systems and practices to help reduce environmental risks. Additionally, these will provide benefits to the health and supply of water, health of soils, health of air and the atmosphere; and ensure compatibility between biodiversity and agriculture. Standards are being developed in four thematic areas: Air, Biodiversity, Pesticides, and Water. Outcomes from NAESI will contribute to the APF goals of improved stewardship by agricultural producers of land, water, air and biodiversity and increased Canadian and international confidence that food from the Canadian agriculture and food sector is being produced in a safe and environmentally sound manner.

The development of agri-environmental performance standards involves science-based assessments of relative risk and the determination of desired environmental quality. As such, the National Agri-Environmental Standards Initiative (NAESI) Technical Series is dedicated to the consolidation and dissemination of the scientific knowledge, information, and tools produced through this program that will be used by Environment Canada as the scientific basis for the development and delivery of environmental performance standards. Reports in the Technical Series are available in the language (English or French) in which they were originally prepared and represent theme-specific deliverables. As the intention of this series is to provide an easily navigable and consolidated means of reporting on NAESI's yearly activities and progress, the detailed findings summarized in this series may, in fact, be published elsewhere, for example, as scientific papers in peer-reviewed journals.

This report provides scientific information to partially fulfill deliverables under the Pesticide Theme of NAESI. This report was written by P. Mineau, T. Dawson, M. Whiteside, C. Morrison, K. Harding, L. Singh, T. Längle, and D.A.R. McQueen. The report was edited and formatted by Denise Davy to meet the criteria of the NAESI Technical Series. The information in this document is current as of when the document was originally prepared. For additional information regarding this publication, please contact:

Environment Canada
National Agri-Environmental Standards
Initiative Secretariat
351 St. Joseph Blvd. 8th floor
Gatineau, QC
K1A 0H3
Phone: (819) 997-1029
Fax: (819) 953-0461

NOTE À L'INTENTION DES LECTEURS

L'Initiative nationale d'élaboration de normes agroenvironnementales (INENA) est un projet de quatre ans (2004-2008) mené conjointement par Environnement Canada (EC) et Agriculture et Agroalimentaire Canada (AAC) et l'une des nombreuses initiatives qui s'inscrit dans le Cadre stratégique pour l'agriculture (CSA) d'AAC. Elle a notamment comme objectifs :

- d'établir des normes nationales de rendement environnemental non réglementaires (applicables dans les régions) qui soutiennent les objectifs communs d'EC et d'AAC en ce qui concerne l'environnement;
- d'évaluer des normes qui sont réalisables par des pratiques de production et de gestion agricoles avantageuses pour l'environnement;
- de faire mieux comprendre les liens entre l'agriculture et l'environnement.

Dans le cadre de l'INENA, des normes de rendement agroenvironnementales (c.-à-d. des normes axées sur les résultats) seront établies pour déterminer les niveaux de qualité environnementale souhaités et les niveaux considérés comme réalisables au moyen des meilleures technologies et pratiques disponibles. AAC intégrera ces normes dans des systèmes et pratiques de gestion bénéfiques en agriculture afin d'aider à réduire les risques pour l'environnement. De plus, elles amélioreront l'approvisionnement en eau et la qualité de celle-ci, la qualité des sols et celle de l'air et de l'atmosphère, et assureront la compatibilité entre la biodiversité et l'agriculture. Des normes sont en voie d'être élaborées dans quatre domaines thématiques : l'air, la biodiversité, les pesticides et l'eau. Les résultats de l'INENA contribueront aux objectifs du CSA, soit d'améliorer la gérance des terres, de l'eau, de l'air et de la biodiversité par les producteurs agricoles et d'accroître la confiance du Canada et d'autres pays dans le fait que les aliments produits par les agriculteurs et le secteur de l'alimentation du Canada le sont d'une manière sécuritaire et soucieuse de l'environnement.

L'élaboration de normes de rendement agroenvironnementales comporte des évaluations scientifiques des risques relatifs et la détermination de la qualité environnementale souhaitée. Comme telle, la Série technique de l'INENA vise à regrouper et diffuser les connaissances, les informations et les outils scientifiques qui sont produits grâce à ce programme et dont Environnement Canada se servira comme fondement scientifique afin d'élaborer et de transmettre des normes de rendement environnemental. Les rapports compris dans la Série technique sont disponibles dans la langue (français ou anglais) dans laquelle ils ont été rédigés au départ et constituent des réalisations attendues propres à un thème en particulier. Comme cette série a pour objectif de fournir un moyen intégré et facile à consulter de faire rapport sur les activités et les progrès réalisés durant l'année dans le cadre de l'INENA, les conclusions détaillées qui sont résumées dans la série peuvent, en fait, être publiées ailleurs comme sous forme d'articles scientifiques de journaux soumis à l'évaluation par les pairs.

Le présent rapport fournit des données scientifiques afin de produire en partie les réalisations attendues pour le thème des pesticides dans le cadre de l'INENA. Ce rapport a été rédigé par P. Mineau, T. Dawson, M. Whiteside, C. Morrison, K. Harding, L. Singh, T. Längle, and D.A.R. McQueen. De plus, il a été révisé et formaté par Denise Davy selon les critères établis pour la Série technique de l'INENA. L'information contenue dans ce document était à jour au moment de sa rédaction. Pour plus de renseignements sur cette publication, veuillez communiquer avec l'organisme suivant :

Secrétariat de l'Initiative nationale
d'élaboration de normes
agroenvironnementales
Environnement Canada

351, boul. St-Joseph, 8eétage
Gatineau (Québec) K1A 0H3
Téléphone : (819) 997-1029
Télécopieur : (819) 953-0461

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

This document directly accompanies the synthesis report on risk-based standards developed for pesticide use in Canada (Mineau *et al.*, 2008). For most key environmental sectors potentially affected by pesticide use, we were able to assemble a sufficient empirical database of terrestrial and aquatic field studies to translate laboratory-based toxicity (hazard) indices into an actual probability of impact. Where possible, our standards are compared with standard regulatory assessments as currently carried out by major regulatory agencies. Information on how the United States Environmental Protection Agency (USEPA) and Pest Management Regulatory Agency (PMRA) risk quotients were generated are included in this report, as well as the associated tables for the different risk indices presented in Mineau *et al.* (2008). Furthermore, we were able to use information from a crop protection survey (carried out by Statistics Canada, and funded by Pesticide Risk Reduction group of the Agricutural Policy Framework of Agriculture and Agri-Food Canada) as an indication of how pesticide use data could be transformed into environmental impact scores with an eye to determining whether applications would meet the proposed National Agri-Environmental Standards Initiative (NAESI) environmental standards.

For the purpose of presenting our results, we adopted a three-tier system analogous to the universally accepted traffic light system. Pesticide applications are labelled as green, yellow or red. 'Green-listed' pesticide applications are those meeting the ideal standard, i.e., considered at this point in time to be reasonably benign, or capable of causing easily reversible impacts. 'Yellow-listed' pesticide applications require caution and likely mitigation, because they are considered to be below an ideal standard. 'Red-listed' applications are those thought to be so far below the standard of acceptability that immediate measures are needed to reduce their predicted impact on the environment. The three-tier assessment is an attempt to simplify continuous scores

between 0 and 1. The actual risk scores, typically expressed as a probability of impact or probability of breaching a very high risk level, are also presented for a finer assessment of risk tradeoffs.

2 MAMMALIAN AND AVIAN RISK QUOTIENT ESTIMATION IN USE BY THE USEPA AND PMRA

In an attempt to compare our terrestrial rankings developed through the NAESI project to other registration agencies such as the PMRA and USEPA, a comparison exercise was undertaken. This exercise consisted of creating first tier rankings in the same way that the USEPA and PMRA do. To do this, we needed up-to-date toxicity data.

Toxicity data was selected from our databases for Mallard Ducks and Bobwhite Quails. Toxicity data from the USEPA one-liner databases codes these data as either “core” or “supplementary”. Only the latest/newest “core” studies were accepted, however, supplementary studies were accepted on the rare occasion that a core study wasn’t present.

An update of the databases with the one-liner January 2007 information occurred prior to extracting this toxicity data.

Rat toxicity data was taken from our mammalian toxicity database and when multiple values existed, the most conservative was used.

2.1 USEPA Acute Risk - Liquids

Estimated Environmental Concentration (EEC) values and risk quotients generated for the USEPA comparison came directly from the T-REX Version 1.3.1 User’s Guide (http://www.epa.gov/oppefed1/models/terrestrial/index.htm). All formulas were taken directly from this guide or the associated T-REX 1.3.1 spreadsheet. LD_{50} and No Observed Adverse Effects Level (NOAEL) values were adjusted depending on the weight of the test species, as

described later in this section. EEC values were converted to dose values to be comparable to the LD_{50}'s. This was done using the following formula:

Application Rate * Kenaga nomogram value = Kenaga EEC **(Equation A1)**

EPA Dose Value = (Kenaga EEC * FI)/BW **(Equation A2)**

Where:

FI = Food Intake (kg diet/day) and

BW = Body Weight (kg) of the assessed mammal.

Multiplying the application rate by the Kenaga value accounts for residues on small insects and broadleaf plants. The nomogram values are based on the work by Hoerger and Kenaga (1972), which was modified by Fletcher in 1994.

2.1.1 Mammal Diet:

For the acute and chronic mammal scenario, a 35 g mammal was used. This was selected as it was the closest match to our 25 g herbivorous small mammal scenario. All exposures were taken to be "worst case scenario" herbivorous mammals eating a diet of short grass.

2.2.2 Avian Diet:

A 20 g bird was used for our acute scenario. Avian exposures were assumed to be through a diet of small insects, as it gives the highest exposure for a realistic diet. The USEPA lists the Kenaga nomogram value for "Broadleaf plants and small insects", so we assumed that this was the scenario that would be used for a tier 1 assessment. There is plenty of variability in the reported residue concentrations on insects, and this category fits within the range of known insect residue values.

Mammalian and avian LD_{50} values were adjusted (according to the weight of the test species) using the following equations:

$$\text{Adj. } LD_{50} = LD_{50} \times (TW/AW)^{0.25} \quad \textbf{(Equation A3)}$$

Where:

TW = body weight of tested animal (Rat – 350g)

And AW = body weight of assessed animal (35g)

Avian LD_{50} values were adjusted using a similar formula:

$$\text{Adj. } LD_{50} = LD_{50} \times (AW/TW)^{0.15} \quad \textbf{(Equation A4)}$$

TW = body weight of tested bird (Bobwhite Quail – 178g or Mallard – 1580g)

AW = Assessed body weight (20 g)

The following body weights and food intake rates are itemized in Table 1 below:

Table 1: Food intake rates and body weights used to generate a Tier 1 risk quotient for the USEPA.

Species	Body Weight (g)	Kenaga Nonogram Value	FI (kg diet/day)
Mammal	35	240	0.0231
Birds	20	135	0.0228

With both an adjusted LD_{50} value and a dose calculated, a tier 1 risk quotient (RQ) can be calculated. This is done by dividing the exposure (dose) by the adjusted LD_{50} value. The USEPA uses the values in Table 2 as level of concern values for these assessments.

Table 2: Ecological risk presumptions, and corresponding USEPA levels of concern (LOC).

Presumed Risk Category	Regulatory Significance	RQ LOC Terrestrial Animals
Acute High	Potential for acute risk is high and regulatory action may be warranted in addition to restricted use classification	0.5
Acute Restricted Use	Potential for acute risk is high but may be mitigated through restricted use classification	0.2
Acute Endangered Species	Potential for acute risk to endangered species is high and regulatory action may be warranted	0.1
Chronic Risk	Potential for chronic risk is high and regulatory action may be warranted	1

2.2 USEPA Seed Treatments - Acute

Application rates for seeds were taken directly from our database, which contain the label information for seed treatments in Canada. To make them comparable to the US, the units needed to be converted from mL/kg of seed to fl oz/cwt.

Using the conversion of 29.574 oz per mL and 45.359 cwt per kg, rates were converted from the mL/kg seed application rates provided from the Canadian pesticide label to fl. Oz/cwt.

The formula to convert the application rates (oz/cwt → lbs ai/cwt) is as follows:

Application Rate (lbs ai/cwt) = Density* (lbs/gal) x ((Application Rate (fl oz/cwt) x %AI)/128) **(Equation A5)**

** The default density was assumed to be 8.33 lbs/gal, as noted in the USEPA T-REX spreadsheet.*

The next step was to convert the application rate (lbs ai/cwt) to the Maximum Seed Application Rate (mg ai/kg-seed). This was done by multiplying the maximum application rate (lbs ai/cwt) by 10,000. This was necessary since the unit cwt is equal to 100 lbs, therefore converting from lbs ai/100lbs-seed to mg ai/kg-seed requires a conversion factor of 10,000.

The final calculation to determine the acute risk for seed treatments was in the form of daily dose. This was taken directly from the T-REX document for Avian and Mammalian Nagy doses. The equation to calculate the Nagy Dose is listed below (Equation A6), and the associated body weights and ingestion rates are listed in Table 3. The scenarios for a 20 g bird, and a 15 g mammal are the only two scenarios the EPA has for performing a tier 1 risk assessment for seed treatments.

Table 3: Nagy Allometry food ingestion values and body weight of assessed animals taken directly from the T-REX spreadsheet.

Animal	Nagy Allometry Food Ingestion Value (g/day)
20g Bird	5.06178
15g Mammal	3.17808

Nagy Dose (mg ai/kg-bw) = (nagy food ingestion value (g/day) x 0.001kg/g x Max seed application rate (mg/kg-seed))/body weight of animal (kg) **(Equation A6)**

A risk quotient (RQ) is then generated for a tier 1 assessment using the Nagy Dose value and dividing it by the appropriate adjusted LD_{50} value. This value is then compared to the level of concern (LOC) values identified in Table 2.

2.3 USEPA Seed Treatments – Chronic

No Observed Effect Concentration (NOEC) values were taken from the USEPA one-liner database, as described above. The Maximum Seed Application Rate (mg ai/kg-seed) was calculated as described in the previous section.

To generate a chronic avian RQ for seed treatments, the Maximum Seed Application Rate is divided by the NOEC value with a level of concern of 1 (as listed in Table 2).

2.4 USEPA Acute Granular Treatments - Avian

In order to determine how the USEPA would rank specific granular treatments, the mass of active ingredient per granule was taken directly from previous calculations reported in Whiteside et al. (2006).

LD_{50} values for both the Bobwhite Quail and Mallard Duck were taken from the USEPA one-liner database, as described above, and the most conservative LD_{50} was chosen for the risk assessment. This LD_{50} value was then modified to account for the weight of the test species using Equation A4. The next step was to convert the LD_{50} value into the mg of ai required to reach the adjusted LD_{50}. This was done by multiplying the assessed bird weight (in Kg) by the Adjusted LD_{50} value. The value was then divided by the mass of ai per granule to give the number of granules needed to achieve the adjusted LD_{50} value.

2.5 USEPA Chronic Liquid - Avian

NOEC values were taken from the USEPA one-liner database and the most conservative value (either Bobwhite Quail or Mallard Duck) was chosen. To calculate the exposure, the application rate was multiplied by the Kenaga value for residues on small insects and broadleaf plants. The exposure value was then divided by the most conservative NOEC value to derive a risk quotient. This risk quotient was then compared to levels of concern (LOC) values listed in Table 2.

2.6 PMRA Acute Risk - Liquids

First tier risk quotient (RQ) values were generated using several scenarios taken directly from the PMRA draft guidance document. To match the 20 g vole scenario we've calculated, a 35 g herbivore eating a diet of only short grass was selected. For the avian portion of the risk assessment, the 20 g bird scenario was adopted from the PMRA eating a diet of only small

insects. Table 4 below lists the associated food ingestion rates (FIR), moisture content and the final equation used to calculate the Estimated Daily Exposure (EDE), which is the dose value.

Table 4: Weights, Food Intake Rates (FIR) and other values required to determine the Estimated Daily Dose (EDE) for both the 35 g Mammal and 20 g Bird.

Generic Weight (g)	FIR (g dry weight diet/day)	Food Guild	Food Category	% Moisture	FIRww (g wet weight diet/day)	Residues on dietary item (mg ai/kg wet weight)	EDE (mg ai/kg bw/day)
35 Mammal	4.5	Herbivore	Short Grass	70%	15	214 x AR*	92 x AR*
20 Bird	5.1	Insectivore	Small Insects	73%	18.9	52 x AR*	49 x AR*

**Where AR = Application Rate (kg ai/ha)*

The FIRww value is calculated using the following equation:

FIRww (g wet weight diet/day) = FIR / (1-Moisture) **(Equation A7)**

The proportion of body weight consumed per day was then calculated using the FIRww value and dividing it by the body weight of the animal. This was then followed by calculating the EDE value using the proportion of body weight consumed, the EEC nomogram value (52 for small insects, 214 for short grass), and the application rate (kg ai/ha).

The calculation for the estimated daily exposure (EDE) dose value is as follows:

EDE(mg ai/kg bw/day) = Proportion body weight consumed x EEC nomogram x application rate (**Equation A8)**

The EDE value was divided by an adjusted LD_{50} value to obtain a risk quotient. The LD_{50} value is from the database described above and is for a lab rat. The LD_{50} value was adjusted by dividing by an uncertainty factor of 10 (to account for the interspecies variability).

The generated RQ value is compared to the level of concern of 1 to determine if the product should be screened more thoroughly.

2.7 PMRA Seed Treatments - Acute

The PMRA handles the seed treatments quite differently from the USEPA. The toxicity value is converted to a toxicity endpoint, which represents the number of seeds ingested per day to reach the endpoint. To convert to this endpoint, the body weight of the test animal (in kg), the seeding application rate – taken directly from our seed treatment database, and the LD_{50} value were used. The formula below shows the conversion from a typical LD_{50} value to a toxicity endpoint in number of seeds:

Toxicity Endpoint (# seeds per day to reach endpoint) = (LD_{50} (mg/kg bw/day) * BW of assessed animal (kg))/Seeding Application Rate (mg ai/seed) **(Equation A9)**

where BW = Body Weight in kg

Table 5: Number of seeds based on the upper limit of the range provided by the Department of Agriculture, Food and Rural Development – Alberta.

Crop	Number of seeds/g
Canola	333
Cereals	32.2
Corn	2.63

The last step to determine the dosage of seeds per day to reach the endpoint requires multiplying the food ingestion rate (FIR dry weight, listed in Table 4), by the number of seeds per gram (listed in Table 5). This gives the EDE value in number of seeds consumed per day.

A risk quotient is generated using the EDE value and the modified toxicity endpoint value by dividing exposure by toxicity. A level of concern value is set roughly at 1 for this tier 1

assessment.

2.8 PMRA Chronic Liquid Treatment – Avian

EDE values were calculated for a 20 g bird as described above.

The most conservative NOEC value was then taken from the USEPA one-liner database and modified by Equation A10 to convert it to a No Observed Effect Level (NOEL) value. Appropriate food consumption rates and body weights were taken from Table 6.

NOEL = (NOEC (mg/kg food) x FIR(kg/day))/BW (kg) **(Equation A10)**

Table 6: PMRA's average body weight and food intake rates used to calculate an NOEL from a NOEC.

	Body weight (kg)	**Food Intake Rate (kg food/day)**
Bobwhite Quail	0.178	0.0189
Mallard Duck	1.082	0.0612

The RQ is generated by dividing the EDE (exposure) value by the NOEL, with a level of concern value being set at 1.

2.9 PMRA Chronic Seed Treatment – Avian

NOEL values were converted from NOEC values, as described in the previous section using Equation A10. The toxicity value (NOEL) is then converted to a toxicity endpoint (number of seeds to reach toxicity), in the same manner described in the acute seed treatment section. The exposure, in this case dose (EDE), is also calculated the same as described in the acute seed treatment section.

Using the dose value and the new toxicity endpoint, the exposure is divided by the toxicity value to generate a risk quotient. The level of concern value in this case is 1.

3 AVIAN RISK SCORES IN THE FORM OF PROBABILITIES OF KILL FOR ALL AGRICULTURAL PESTICIDES REGISTERED IN CANADA.

The following table shows the avian risk scores, in the form of probabilities of kill, for all agricultural pesticides registered in Canada. All applications are assumed to be foliar applications at the maximum application rate allowed on the label. To aid visualization of the results, we used the green-yellow-red classification (described in the introduction). Risk quotients calculated from USEPA, PMRA, and EU methodology are also provided for comparison.

The USEPA provides three acute levels of concern (RQ triggers) for terrestrial animals: 0.5 (where the potential for acute risk is high and regulatory action may be warranted in addition to restricted use classification), 0.3 (where the potential for acute risk is high, but may be mitigated through restricted use classification), and 0.1 (where the potential for acute risk to endangered species is high and regulatory action may be warranted). We used red highlighting for EPA RQs above 0.5, yellow between 0.1 and 0.5, and green below 0.1. Canadian RQs are computed somewhat differently and guidelines provide a single level of concern of 1. Therefore, all applications with an RQ>1 are in red, those below are in green. All registered active ingredients are listed in the table in decreasing order of risk.

EU proposed screening risk quotients in the form of Bobwihte/Mallard LD_{50}s per m^2 are also shown in the table. A red label was given to trigger values of 0.5 and above (>10% probability of a kill), yellow for 0.3 to 0.5 (a probability of kill not exceeding 10%) and green to less than 0.3 (a level that did not cause mortality in any of the studies examined).

Inspection of predicted probabilities of kill for registered compounds, as well as consideration of North American and European risk quotients, suggests that a probability of 10% is a reasonable and achievable cut-off. For example, several incidents of avian mortality have been recorded with

dimethoate (http://www.abcbirds.org/aims/), a compound that has a calculated probability of mortality of 0.13 when used at maximum label rate (although, based on toxicity alone, it rates much worse). In contrast, compounds with calculated probabilities lower than 0.10 seldom if ever appear in the kill record.

A quick comparison of our assessment with that of the USEPA or PMRA shows that there would be little argument about applications estimated to not meet our proposed standard. Based on initial levels of concern, USEPA and PMRA procedures are more protective than our standard, but this is normal for a screening-level assessment. It is difficult to explain the continued use of pesticides with risk quotients in the thousands when the regulatory level of concern is supposed to be 1 or lower – barring overwhelming agricultural benefits from those applications. One notable disagreement between our assessments and those of other regulatory agencies is the insecticide phosmet. This discrepancy was raised by Richards *et al.* (2004). In their assessment, the USEPA used the high toxicity endpoints for the Mallard and Bobwhite and ignored the much higher documented sensitivity of small-bodied species to this insecticide. The PMRA also raised the issue of a potentially high risk to small birds (http://www.pmra-arla.gc.ca/english/pdf/pacr/pacr2004-38-e.pdf). The other important discrepancies are the above-noted insecticides that are considered high risk in USEPA/PMRA screening assessments, but considered to pose minimal risk in our models: methomyl, pirimicarb and carbaryl.

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
CAF	Carbofuran	1563662	Insecticide	1.2	1.00	77.15	661.11	1227.78
DIA	Diazinon	333415	Insecticide	11.6	1.00	305.69	2130.23	3956.17
DUB	Chlorpyrifos	2921882	Insecticide	4.995	1.00	10.16	29.75	76.66
MOM	Methamidophos	10265926	Insecticide	1.104	1.00	11.93	34.43	63.94
ACP	Acephate	30560191	Insecticide	2.55	0.98	0.50	1.93	3.58
NAL	Naled	300765	Insecticide	1.9008	0.96	3.64	9.63	17.88
GOO	Azinphos-methyl	86500	Insecticide	2.22	0.89	3.37	13.22	34.07
OXB	Oxamyl	23135220	Insecticide	2.244	0.85	71.01	187.79	348.75
PRT	Phosmet	732116	Insecticide	1.875	0.76	0.10	0.27	0.50
THI	Thiram	137268	Fungicide	30	0.63	1.07	2.83	5.26

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
FOM	Formetanate (form not specified)	23422539	Insecticide	4.1216	0.62	18.87	94.78	176.01
CAP	Captan	133062	Fungicide	12.5	0.51	0.60	1.65	3.07
ESF	Endosulfan	115297	Insecticide	4.5	0.50	12.43	38.14	70.83
DIK	Dichloran	99309	Fungicide	33	0.43	2.46	6.99	18.01
EPT	EPTC	759944	Herbicide	6.8	0.36	0.43	1.80	3.34
TRI	Trichlorfon	52686	Insecticide	3.2	0.34	11.15	27.23	70.16
ZIR	Ziram	137304	Fungicide	6.8	0.33	7.01	13.36	34.43
DCB	Dichlobenil	1194656	Herbicide	9	0.20	0.77	2.51	6.47
CUY	Copper (copper oxychloride)	1332407	Fungicide	4.5	0.18			
NBP	Napropamide	15299997	Herbicide	6.7	0.16	0.50	2.19	4.06

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
DXB	2,4-D (unspecified amine salt)	94757	Herbicide	2.76	0.16	0.28	0.73	1.36
MAS	MCPA (potassium salt)	3653483	Herbicide	2.7	0.13			
DIM	Dimethoate	60515	Insecticide	2.4	0.13	3.78	9.99	18.56
LUN	Linuron	330552	Herbicide	4.5	0.13	0.48	0.91	2.35
DIQ	Diquat (form not specified)	2764729	Herbicide	1.104	0.12			
ENT	Endothall (form not specified)	145733	Herbicide	1.364	0.11	0.41	1.58	2.93
DIC	Dicamba (form not specified)	1918009	Herbicide	3.4293	0.11	0.63	3.03	7.80
BAX	Metribuzin	21087649	Herbicide	2.25	0.11	1.37	2.61	6.74
MBS	MCPB (sodium salt)	6062266	Herbicide	1.7	0.10	0.60	1.15	2.96
CHL	Chlorthal (form not specified)	1861321	Herbicide	13.5	0.10	0.60	1.14	2.95

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
DXF	2,4-D (unspecified ester)	25168267	Herbicide	3.135	0.10	0.47	1.25	2.32
MAA	MCPA (acid)	94746	Herbicide	1.75	0.09	0.46	0.88	2.28
MAB	MCPA (dimethylammine salt)	94746	Herbicide	2.375	0.09	0.63	1.20	3.09
BET	Bensulide	741582	Herbicide	6.72	0.08	0.48	0.92	2.38
AMZ	Amitraz	33089611	Insecticide	1.675	0.08	0.21	0.41	1.04
IMI	Imidacloprid	1.38E+08	Insecticide	0.312	0.08	0.20	0.39	1.01
PAQ	Paraquat (form not specified)	4685147	Herbicide	1.5	0.07	0.85	1.62	4.19
SUL	Sulphur	7704349	Fungicide	18	0.07			
FAB	N-Octanol	111875	Herbicide	16.082	0.07			
DCF	Dicofol	115322	Insecticide	2.55	0.07			

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
BZN	Bentazon (form not specified)	25057890	Herbicide	1.08	0.07	0.03	0.18	0.45
FER	Ferbam	14484641	Fungicide	6.27	0.07			
FAA	N-Decanol	112301	Growth Regulator	14.44	0.07	0.31	0.82	1.53
GPP	Glyphosate (potassium salt)	70901121	Herbicide	4.32	0.06			
MAL	Malathion	121755	Insecticide	3.75	0.06	0.25	0.67	1.24
DUR	Diuron	330541	Herbicide	5.4	0.06	0.39	1.09	2.82
GPT	Glyphosate (trimethylsulfonium salt)	81591813	Herbicide	3.97	0.06	0.42	1.11	2.05
CCC	Chlormequat (form not specified)	999815	Growth Regulator	1.38	0.05			
TPR	Triclopyr	55335063	Herbicide	3.84	0.05	0.23	0.60	1.11

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
GPM	Glyphosate (mono-ammonium salt)		Herbicide	4.35	0.05			
GPS	Glyphosate (acid)	1071836	Herbicide	4.95	0.05	0.25	0.47	1.22
FOL	Folpet		Fungicide	5	0.05	0.22	0.66	1.23
DXA	2,4-D (acid)		Herbicide	2.726	0.04	0.27	0.72	1.34
AMI	Amitrole	61825	Herbicide	10.63	0.04	0.49	0.94	2.43
TET	Chlorothalonil	1897456	Fungicide	5.8	0.04	0.13	0.33	0.61
MTR	Metiram	9006422	Fungicide	4.8	0.04			
DOD	Dodine (dodecylguanidine monoacetate)	2439103	Fungicide	2.1125	0.04	0.23	0.65	1.21
GPI	Glyphosate (isopropylamine salt)	38641940	Herbicide	4.32	0.04	0.11	0.21	0.55
NAP	Naptalam (form not specified)	132661	Herbicide	7.2	0.03	0.16	0.41	0.76

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
MAH	Maleic hydrazide (form not specified)	123331	Growth Regulator	3.39	0.03	0.07	0.19	0.36
MEW	Mecoprop d-isomer (potassium salt)		Herbicide	1.05	0.03			
FOR	Formaldehyde	50000	Fungicide	1.1877	0.03			
MEA	Mecoprop (potassium salt)	1929868	Herbicide	1.155	0.03	0.21	0.40	1.04
TER	Terbacil	5902512	Herbicide	3.6	0.03	0.16	0.30	0.79
ZIN	Zineb	12122677	Fungicide	2.64	0.03			
MEZ	Mecoprop d-isomer (amine salt)		Herbicide	0.85	0.03			
PYZ	Pyrazon (chloridazon)	1698608	Herbicide	4.4075	0.03			
DIH	Dichlorprop (form not specified)	53404312	Herbicide	0.525	0.02	0.04	0.28	0.73
DYR	Anilazine	101053	Fungicide	3.375	0.02	0.17	0.45	0.83

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
MEC	Mecoprop (form not specified)	1929868	Herbicide	0.85	0.02			
CUZ	Copper (copper hydroxide)	20427592	Fungicide	2.25	0.02			
MCZ	Mancozeb	8018017	Fungicide	7.2	0.02			
PIC	Picloram (form not specified)	1918021	Herbicide	2.16	0.02	0.09	0.23	0.42
ATR	Atrazine	1912249	Herbicide	4	0.02	0.29	0.81	2.09
DPB	2,4-DB (form not specified)	94826	Herbicide	1.71875	0.02	0.11	0.21	0.55
IPD	Iprodione	36734197	Fungicide	1.5	0.02	0.03	0.14	0.37
MET	Methoxychlor	72435	Insecticide	2.7	0.02	0.14	0.36	0.66
ETF	Ethephon	16672870	Growth Regulator	3.36	0.02	0.17	0.44	0.83
AMN	Aminoethoxyvinylglycine	55720268	Growth Regulator	0.125	0.02			

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
MTL	Metolachlor	51218452	Herbicide	2.148	0.02	0.05	0.12	0.23
TRL	Triallate	2303175	Herbicide	2.208	0.02	0.10	0.19	0.48
TRF	Trifluralin	1582098	Herbicide	2.016	0.02	0.10	0.27	0.50
ETS	Ethofumesate	67293747	Herbicide	3.96	0.02			
MFN	Metalaxyl-m (mefenoxam)	70630170	Fungicide	1.111	0.02	0.11	0.22	0.56
NXI	Acetamiprid	1.35E+08	Insecticide	0.168	0.02	0.19	0.51	0.95
PEN	Pendimethalin	40487421	Herbicide	1.088	0.02	0.08	0.20	0.38
DPA	Diphenylamine	122394	Fungicide	2.048	0.02	0.09	0.17	0.45
VPR	Hexazinone	51235042	Herbicide	2.025	0.02	0.09	0.17	0.44
PRO	Prometryne	7287196	Herbicide	3.4	0.02	0.07	0.19	0.36

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
MEI	Dimethenamid	87674688	Herbicide	1.683	0.02	0.09	0.17	0.43
MAN	Maneb	12427382	Fungicide	2.6	0.02			
AME	S-Metolachlor	87392129	Herbicide	1.60125	0.01	0.06	0.17	0.31
QTZ	Quintozene	82688	Fungicide	1.6875	0.01	0.08	0.15	0.39
MAE	MCPA (unspecified ester)	94746	Herbicide	1.75	0.01	0.46	0.88	2.28
EFR	Ethalfluralin	55283686	Herbicide	1.4	0.01	0.07	0.13	0.34
ACA	Acifluorfen (form not specified)	62476599	Herbicide	0.6	0.01	0.05	0.35	0.91
PHS	Phosalone	2310170	Insecticide	0.625	0.01			
FAL	Fosetyl-al	39148248	Fungicide	4.48	0.01	0.06	0.11	0.28
SMZ	Simazine	122349	Herbicide	5.4	0.01	0.12	0.31	0.57

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
AVG	Difenzoquat (methyl sulphate salt)	43222486	Herbicide	0.85	0.01	0.05	0.14	0.26
FLT	Flufenacet	1.42E+08	Herbicide	0.79968	0.01			
CNQ	Clomazone	81777891	Herbicide	1.116	0.01	0.04	0.12	0.22
IMP	Imazethapyr	81335775	Herbicide	0.951521	0.01	0.04	0.12	0.22
MMM	Thifensulfuron-methyl	79277273	Herbicide	1.2375	0.01	0.05	0.13	0.24
GLG	Glufosinate ammonium	77182822	Herbicide	1.0005	0.01	0.05	0.13	0.25
MOR	Chinomethionat	2439012	Fungicide	0.5	0.01	0.26	0.49	1.25
TZL	Thiabendazole	148798	Fungicide	1	0.01	0.03	0.08	0.22
FEX	Fenhexamid	1.27E+08	Fungicide	0.85	0.01	0.04	0.08	0.21
VIL	Vinclozolin	50471448	Fungicide	1	0.01	0.04	0.08	0.20

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
BTL	Desmedipham	13684565	Herbicide	0.7125	0.01	0.04	0.07	0.17
TPM	Thiophanate-methyl	23564058	Fungicide	1.575	0.01	0.03	0.09	0.17
PHY	Propamocarb hydrochloride		Fungicide	1.0125	0.01			
KRB	Propyzamide	23950585	Herbicide	2.25	0.01	0.01	0.03	0.06
CYP	Cyprodinil	1.22E+08	Fungicide	0.5625	0.01	0.06	0.30	0.55
MYC	Myclobutanil	88671890	Fungicide	0.136	0.01	0.03	0.05	0.13
ASS	Imazamethabenz (form not specified)		Herbicide	0.49982	0.01			
PYD	Pyridaben	96489713	Insecticide	0.54	0.00	0.02	0.05	0.12
DPP	Diclofop-methyl	51338273	Herbicide	0.994	0.00	0.04	0.08	0.22
PMP	Phenmedipham	13684634	Herbicide	0.7125	0.00	0.03	0.09	0.17

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
BRY	Bromoxynil (octanoate)	1689992	Herbicide	0.3375	0.00	0.05	0.38	0.98
DPI	Clopyralid	1702176	Herbicide	0.20025	0.00	0.01	0.04	0.07
DIN	Dinocap	6119922	Fungicide	0.31725	0.00	0.01	0.03	0.07
MPR	(S)-Methoprene	40596698	Insecticide	0.238	0.00	0.01	0.03	0.06
AZY	Azoxystrobin	1.32E+08	Fungicide	0.28125	0.00	0.04	0.30	0.55
TFZ	Tebufenozide	1.12E+08	Insecticide	0.288	0.00	0.01	0.03	0.07
DME	Dimethomorph	1.1E+08	Fungicide	0.225	0.00	0.01	0.03	0.06
SOD	Sethoxydim	74051802	Herbicide	0.495	0.00	0.02	0.05	0.10
ZOX	Zoxamide	1.56E+08	Fungicide	0.224	0.00	0.01	0.02	0.06
TCM	2-(Thiocyanomethylthio)benzothiazole	21564170	Fungicide	0.0736	0.00	0.01	0.02	0.05

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
MXF	Methoxyfenozide	1.61E+08	Insecticide	0.24	0.00	0.01	0.02	0.05
PYA	Pyraclostrobin	1.75E+08	Fungicide	0.225	0.00			
CYM	Cypermethrin	52315078	Insecticide	0.94967	0.00	0.01	0.02	0.05
OXR	Oxyfluorfen	42874033	Herbicide	0.496	0.00			
FAD	Famoxadone	1.32E+08	Fungicide	0.21	0.00	0.01	0.02	0.05
PFL	Permethrin	52645531	Insecticide	2.5	0.00	0.13	0.33	0.61
FLZ	Fluazinam	79622596	Fungicide	0.16	0.00	0.01	0.02	0.04
CYO	Cymoxanil		Fungicide	0.21	0.00			
TRR	Triforine		Fungicide	0.585	0.00	0.03	0.06	0.14
FZA	Fluazifop-p-butyl	79241466	Herbicide	0.25	0.00	0.01	0.02	0.03
MEX	Tribenuron methyl	1.01E+08	Herbicide	0.1875	0.00	0.01	0.02	0.04

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
TRA	Tralkoxydim	87820880	Herbicide	0.2	0.00			
PON	Propiconazole	60207901	Fungicide	0.19	0.00	0.01	0.02	0.04
SPI	Spinosad	1.32E+08	Insecticide	0.1056	0.00	0.01	0.02	0.04
FLR	Fluroxypyr 1-methylheptyl ester		Herbicide	0.144	0.00			
CFZ	Clofentezine	74115245	Insecticide	0.3	0.00	0.01	0.03	0.05
QUC	Quinclorac	84087014	Herbicide	0.12375	0.00	0.01	0.02	0.03
TFY	Trifloxystrobin	1.42E+08	Fungicide	0.1225	0.00	0.01	0.01	0.03
FPF	Fenoxaprop-p-ethyl	71283802	Herbicide	0.100625	0.00	0.00	0.01	0.02
FOF	Fomesafen	72178020	Herbicide	0.24	0.00	0.00	0.01	0.02
PZN	Pymetrozine	1.23E+08	Insecticide	0.0965	0.00	0.04	0.82	1.52

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
CYZ	Cyromazine	66215278	Insecticide	0.27975	0.00	0.01	0.03	0.08
FED	Fenamidone	1.61E+08	Fungicide	0.1	0.00	0.01	0.01	0.02
IXF	Isoxaflutole	1.41E+08	Herbicide	0.1056	0.00	0.00	0.01	0.02
CFP	Clodinafop-propargyl	1.06E+08	Herbicide	0.0696	0.00	0.00	0.01	0.02
BAD	6-Benzyladenine	1214397	Growth Regulator	0.07632	0.00	0.00	0.01	0.02
CLE	Clethodim	99129212	Herbicide	0.0912	0.00			
KRS	Kresoxim-methyl	1.43E+08	Fungicide	0.225	0.00	0.01	0.02	0.05
FBZ	Fenbuconazole	1.2E+08	Fungicide	0.105	0.00	0.00	0.01	0.02
TEU	Tebuconazole	80443410	Fungicide	0.126144	0.00	0.01	0.01	0.03
QPE	Quizalofop p-ethyl	1.01E+08	Herbicide	0.072	0.00	0.00	0.01	0.02

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
MEM	Metsulfuron-methyl	74223646	Herbicide	0.09	0.00	0.00	0.01	0.02
MER	Mesotrione	1.04E+08	Herbicide	0.144	0.00	0.01	0.01	0.04
FLM	Flumetsulam	98967409	Herbicide	0.070668	0.00	0.00	0.01	0.02
BMS	Flusilazole	85509199	Fungicide	0.04	0.00			
TPA	Tepraloxydim	1.5E+08	Herbicide	0.05	0.00			
DBR	Deltamethrin	52918635	Insecticide	0.02	0.00	0.00	0.00	0.00
NAD	Naphthaleneacetamide	86862	Growth Regulator	0.1668	0.00	0.01	0.01	0.03
PFN	Picolinafen	1.38E+08	Herbicide	0.05025	0.00			
CUS	Copper (copper sulphate)	7758987	Algicide, Fungicide	0.00825	0.00	0.00	0.00	0.00
CLM	Cloransulam (form not specified)	1.47E+08	Herbicide	0.035028	0.00			

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
TFS	Triflusulfuron methyl	1.27E+08	Herbicide	0.035	0.00	0.00	0.00	0.01
FMS	Foramsulfuron	1.73E+08	Herbicide	0.03	0.00	0.00	0.00	0.01
DFZ	Difenoconazole	1.19E+08	Fungicide	0.026286	0.00	0.00	0.00	0.01
FLS	Flucarbazone-sodium		Herbicide	0.02838	0.00	0.00	0.00	0.01
PRI	Primisulfuron-methyl	86209510	Herbicide	0.03	0.00	0.00	0.00	0.01
IMZ	Imazamox	1.14E+08	Herbicide	0.0252	0.00	0.00	0.00	0.01
PID	Picloram (triisopropanolamine salt)	1918021	Herbicide	0.024	0.00	0.00	0.00	0.00
DFF	Diflufenzopyr (form not specified)	1.09E+08	Herbicide	0.057	0.00	0.00	0.00	0.01
NIO	Nicosulfuron	1.12E+08	Herbicide	0.02505	0.00	0.00	0.00	0.01
TRS	Triasulfuron	82097505	Herbicide	0.02475	0.00	0.00	0.00	0.01

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
PSF	Prosulfuron	94125345	Herbicide	0.009975	0.00	0.00	0.00	0.00
ETM	Ethametsulfuron (form not specified)	97780068	Herbicide	0.0225	0.00	0.00	0.00	0.00
SLF	Sulfosulfuron	1.42E+08	Herbicide	0.02025	0.00	0.00	0.00	0.00
DPY	Rimsulfuron	1.23E+08	Herbicide	0.015	0.00	0.00	0.00	0.00
CHH	Boscalid	1.88E+08	Fungicide	0.539	0.00	0.03	0.05	0.13
CYH	Cyhalothrin-lambda	91465086	Insecticide	0.022936	0.00	0.00	0.00	0.00
FRA	Florasulam	1.46E+08	Herbicide	0.005	0.00			
CHE	Chlorimuron-ethyl	90982324	Herbicide	0.009	0.00	0.00	0.00	0.00
TRT	Triticonazole	1.32E+08	Fungicide	0.006	0.00	0.00	0.00	0.00
CSL	Chlorsulfuron	64902723	Herbicide	0.01125	0.00	0.00	0.00	0.00

Table 7: Avian risk scores (as probabilities of kill) for all agricultural pesticides registered in Canada assuming maximum application rate and foliar applications. Risk quotients obtained following USEPA, PMRA, and EU methodology are provided for comparison, as described in the text.

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Best estimate of risk from three separate models - direct, indirect inhibitors and all others	Proposed EU screening trigger: No. LD50/sq.m.based on Mallard & Bobwhite geomean	USEPA RQ	PMRA RQ
PYR	Pyrethrins	121211	Insecticide	0.01	0.00	0.00	0.00	0.00
IDO	Iodosulfuron-methyl-sodium	1.45E+08	Herbicide	0.002	0.00	0.00	0.00	0.00
FLD	Fludioxonil	1.31E+08	Fungicide	0.001898	0.00	0.00	0.00	0.00
HEC	Hexaconazole	79983714	Fungicide	0.001892	0.00			
NAA	1-Naphthalene actetic acid (form not specified)	86873	Growth Regulator	0.000001136	0.00	0.00	0.00	0.00
CAB	Carbaryl	63252	Insecticide	9.804	0.00	0.38	1.01	1.88
MML	Methomyl	16752775	Insecticide	1.935	0.00	9.86	32.18	59.77
PIR	Pirimicarb	23103982	Insecticide	0.85	0.00	4.94	13.07	24.27

4 ACUTE AVIAN RISK SCORES FOR SEED TREATMENTS REGISTERED IN CANADA.

Table 8 shows the acute avian risk scores for seed treatments registered in Canada. Risk quotients calculated from USEPA and PMRA methodology are provided for comparison as well. Again the three-tiered red/yellow/green system is used to present our results.

Seed treatments were ranked by the number of particles required to kill a 15 g bird (or 50 g bird for corn). In order to reflect the relative attractiveness of different seed types to birds, the Use Pattern Application Factors (UPAFs) were used as a multiplier of the product's relative risk (see Mineau *et al.*, 2008; Section 2.3.1).

Results for seed treatment chemicals in the corn, cereal and oilseed clusters are presented here. For the purpose of assigning an adjustment factor, the cereal cluster product was assumed to refer to wheat. The risk for all products expected to cause mortality with one seed or less was adjusted to reflect a risk of 1, and other products were ranked in comparison. Any seed treatment with an adjusted risk index of 1 (i.e., capable of causing mortality following ingestion of 1-2 seeds of a preferred type) should, in our opinion, be 'red-listed'. Even if the product is a sensory repellent or capable of leading to learned avoidance, an avoidance response is unlikely to be effective with such a low margin of safety. In the absence of field studies, we propose to set a provisional standard of 0.1 based on our relative risk index. For a small songbird, this corresponds to the ingestion of 20 seeds of a preferred seed type (with an adjustment factor of 2). Because this is well under the maximum meal size recorded for several agricultural species (see Mineau *et al.*, 2008; Section 2.5), setting a standard based on the likelihood that only 20 seeds will be consumed may, therefore, be under-protective. This should be a provisional standard until more field-based information is made available on products of intermediate toxicity. Comparison with USEPA and

PMRA risk quotients suggests that this standard may not be stringent enough to ensure protection of avian species.

Table 8: Acute avian risk scores for seed treatments registered in Canada. Risk quotients calculated from USEPA and PMRA methodology are provided for comparison. Colours for the latter have been assigned as they were for spray applications.

	AI Accepted Name	Type of seed treated	HD5 (Mineau *et al.* 2001)	Risk based on no. seeds to HD5	Raw relative risk	Correction factor to reflect relative seed attractiveness	Relative risk corrected for seed attractiveness	USEPA RQ	PMRA RQ
DIA	Diazinon	Corn	0.59	0.2	1.00	2	1.00	436.60	2582.70
VIT	Carbathiin	Cereal	10.68	1.1	1.00	2	1.00	9.46	22.41
IMI	Imidacloprid	Corn	8.43	0.4	1.00	2	1.00	4.51	162.97
CAP	Captan	Corn	25.32	0.6	1.00	2	1.00	1.12	29.09
VIT	Carbathiin	Corn	10.68	1.1	1.00	2	1.00	0.16	5.75
THI	Thiram	Corn	36.81	2.7	0.37	2	0.75	0.23	6.42
COD	Clothianidin	Corn	41.51	3.5	0.29	2	0.58	0.36	7.85
MTA	Metalaxyl	Corn	89.09	5.6	0.18	2	0.36	0.52	14.13
THE	Thiamethoxam	Corn	98.40	12.6	0.08	2	0.16	0.53	17.73
THI	Thiram	Cereal	36.81	22.7	0.04	2	0.09	0.09	2.78
IMI	Imidacloprid	Canola	8.43	5.3	0.19	0.2	0.04	14.47	522.11
MCZ	Mancozeb	Corn	710.95	53.2	0.02	2	0.04		
MAN	Maneb	Cereal	345.34	69.8	0.01	2	0.03		
TEU	Tebuconazole	Cereal	347.30	88.6	0.01	2	0.02	0.22	9.48
TPM	Thiophanate-methyl	Corn	482.63	90.7	0.01	2	0.02	0.04	1.50
MTA	Metalaxyl	Cereal	89.09	103.3	0.01	2	0.02	0.09	2.83

Table 8: Acute avian risk scores for seed treatments registered in Canada. Risk quotients calculated from USEPA and PMRA methodology are provided for comparison. Colours for the latter have been assigned as they were for spray applications.

	AI Accepted Name	Type of seed treated	HD5 (Mineau *et al.* 2001)	Risk based on no. seeds to HD5	Raw relative risk	Correction factor to reflect relative seed attractiveness	Relative risk corrected for seed attractiveness	USEPA RQ	PMRA RQ
DFZ	Difenoconazole	Corn	207.13	113.1	0.01	2	0.02	0.03	1.11
THE	Thiamethoxam	Cereal	98.40	126.2	0.01	2	0.02	0.17	6.51
MFN	Metalaxyl-m (mefenoxam)	Corn	137.00	127.7	0.01	2	0.02	0.04	1.43
THI	Thiram	Canola	36.81	28.0	0.04	0.2	0.01	0.28	23.31
DFZ	Difenoconazole	Cereal	207.13	368.4	0.00	2	0.01	0.03	1.26
NXI	Acetamiprid	Canola	20.91	41.5	0.02	0.2	0.00	11.06	287.92
MFN	Metalaxyl-m (mefenoxam)	Cereal	137.00	415.8	0.00	2	0.00	0.04	1.61
FLD	Fludioxonil	Corn	208.12	490.3	0.00	2	0.00	0.01	0.28
VIT	Carbathiin	Canola	10.68	53.4	0.02	0.2	0.00	0.13	4.62
COD	Clothianidin	Canola	41.51	64.9	0.02	0.2	0.00	0.44	15.89
THE	Thiamethoxam	Canola	98.40	121.9	0.01	0.2	0.00	2.09	69.66
TLL	Triadimenol	Cereal	965.25	1231.1	0.00	2	0.00		
FLD	Fludioxonil	Cereal	208.12	1744.4	0.00	2	0.00	0.01	0.29
TRT	Triticonazole	Cereal	232.29	1860.8	0.00	2	0.00	0.01	0.32
IPD	Iprodione	Canola	158.40	266.7	0.00	0.2	0.00	0.40	14.76
MTA	Metalaxyl	Canola	89.09	1205.2	0.00	0.2	0.00	0.09	2.51

Table 8: Acute avian risk scores for seed treatments registered in Canada. Risk quotients calculated from USEPA and PMRA methodology are provided for comparison. Colours for the latter have been assigned as they were for spray applications.

	AI Accepted Name	Type of seed treated	HD5 (Mineau *et al.* 2001)	Risk based on no. seeds to HD5	Raw relative risk	Correction factor to reflect relative seed attractiveness	Relative risk corrected for seed attractiveness	USEPA RQ	PMRA RQ
MFN	Metalaxyl-m (mefenoxam)	Canola	137.00	4851.5	0.00	0.2	0.00	0.02	1.43
DFZ	Difenoconazole	Canola	207.13	5021.3	0.00	0.2	0.00	0.03	0.95
FLD	Fludioxonil	Canola	208.12	20351.0	0.00	0.2	0.00	0.01	0.25

5 ACUTE AVIAN RISK SCORES FOR GRANULAR PESTICIDES REGISTERED IN CANADA.

The table below shows the acute avian risk scores for granular pesticides registered in Canada.

Because specific information of granule mass is not publicly available, we assumed equal mass for all active ingredients, and calculated the number of granules to reach the HD_5 for a 15 g songbird. Ratings for past and current granular products (ratings for current granular products are shown here; ratings for other products no longer registered were calculated but are not shown) were compared to known kill incidents. The three most toxic granular products (terbufos, phorate and diazinon) have the potential to kill a 15 g songbird at the 5% tail of the avian sensitivity distribution with a single granule (before application of any factor). We propose that these products be red-listed. With a single granule being capable of causing a lethal intoxication, we would not expect the exact composition of the granule base or any avoidance response to have much influence on the likelihood of poisoning.

It is thought that some granules, especially ones on an organic matrix, may be mistaken for seed or seed fragments. In keeping with the seed standard set forth above, we propose a provisional standard be set at a risk index of 0.1, once the indices have been corrected for attractiveness based on granule composition.

Table 9: Acute avian risk scores for granular pesticides registered in Canada.

AI Code	Pesticide	% guarantee	HD5 (mg/kg)	Risk (No. Granules to HD5 for 15 g bird)	Relative risk
COY	Terbufos	15.00%	0.16	0.08	1.00
PHR	Phorate	15.00%	0.34	0.17	1.00
DIA	Diazinon	5.00%	0.59	0.89	1.00
DUB	Chlorpyrifos	15.00%	3.76	1.88	0.53

Table 9: Acute avian risk scores for granular pesticides registered in Canada.

AI Code	Pesticide	% guarantee	HD5 (mg/kg)	Risk (No. Granules to HD5 for 15 g bird)	Relative risk
DAZ	Dazomet	97.00%	53.33	4.12	0.24
EPT	EPTC	25.00%	25.32	7.60	0.13
EPT	EPTC	10.00%	25.32	18.99	0.05
EPT	EPTC	5.00%	25.32	37.98	0.03
CAB	Carbaryl	5.00%	30.10	45.15	0.02
NBP	Napropamide	10.00%	78.03	58.52	0.02
TRF	Trifluralin	10.00%	245.55	184.16	0.01
TRL	Triallate	10.00%	261.44	196.08	0.01
MTA	Metalaxyl	2.00%	89.09	334.09	0.00
EFR	Ethalfluralin	5.00%	232.29	348.44	0.00
TRF	Trifluralin	5.00%	245.55	368.33	0.00
TEL	Tefluthrin	3.00%	178.63	446.58	0.00
TRF	Trifluralin	4.00%	245.55	460.41	0.00
TRF	Trifluralin	3.00%	245.55	613.88	0.00
MTA	Metalaxyl	1.00%	89.09	668.18	0.00
MFN	Metalaxyl-m (mefenoxam)	1.00%	137.00	1027.50	0.00

6 AVIAN REPRODUCTIVE RISK SCORES FOR FOLIAR LIQUID APPLICATIONS.

The derived risk measure for birds from spray applications is the amount of time that residue levels in food items (insects) remain high enough so that the daily chemical intake of our model bird exceeds the reproductive effect threshold. The mallard and bobwhite endpoints are averaged and adjusted to reflect a 15 g insectivorous bird. See Mineau *et al.*, 2008 for more detail (Section 3.2).

All applications were expressed as the proportion of the total reproductive season (estimated to be approximately 90 days for agricultural songbirds) that they were likely to be interfering with avian reproduction. All products expected to be used during the reproductively active time for

more than 90 days were given the maximum risk score of 1. All pesticides present for over a third (33%) of the total reproductive season were provisionally considered below standard. Assuming that breeding was already underway and a nest was close to fledging, an application that made the nesting attempt fail and prevented re-nesting for a full month would likely remove any chance of successful breeding for that season. Products with a risk score of 1 are red-listed on a provisional basis. However, as has been pointed out (Mineau, 2005) there are serious extrapolation issues between the standard laboratory reproductive tests and avian reproduction in real life. This, and the lack of field validation, should make us cautious of setting a rigid standard based on avian reproduction.

For comparison purposes, both EPA and PMRA chronic RQs have been tabulated also. The proposed level of concern is a RQ of 1 in both jurisdictions. These are clearly much more protective than the provisional standard we have currently set. About 65% of products for which we obtained data would be considered to have an RQ of concern by the PMRA, which suggests that the trigger is too protective. However, given these are all in-use products, it is clear that the trigger does not have any real influence on the registration status of pesticides.

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
BET	Bensulide	6.72	250	3	30	227	1	323.75	2333.91
DIQ	Diquat (form not specified)	1.1	5	5	30	218	1	26.59	191.71
FOM	Formetanate (form not specified)	4.12	53	53	30	173	1	9.37	67.52
DUR	Diuron	5.4	protected		30	149	1	6.5	24.98
CUZ	Copper (copper hydroxide)	2.25	500	100	68.9	194	1	2.71	19.54
VPR	Hexazinone	2.03	100	100	30	115	1	2.44	17.58
TZL	Thiabendazole	1	80	80	30	94	1	1.51	10.85
LUN	Linuron	4.5	100	100	15	75	0.83	5.42	39.07
THI	Thiram	30	500	10	8	64	0.71	376.39	2713.35
MCZ	Mancozeb	7.2	125	125	10	53	0.59	6.94	50.01
PFL	Permethrin	2.5	25	25	8	50	0.55	12.04	86.83
TPR	Triclopyr	3.84	100	100	9.2	44	0.49	4.63	33.34
MOR	Chinomethionat	0.5	58	5	10	44	0.48	12.04	86.83
TRL	Triallate	2.21	200		15	40	0.44	1.33	5.11
DIA	Diazinon	11.6	32	6	4	40	0.44	232.86	1678.66
NBP	Napropamide	6.7		1000	15	38	0.42	0.81	442.82
DCF	Dicofol	2.55		5	4	35	0.39	61.43	5.82
MTL	Metolachlor	2.15	24	7	5	35	0.38	39.79	286.87
SMZ	Simazine	5.4	100	20	5	32	0.36	32.52	234.43
MTR	Metiram	4.8	500	50	7	31	0.34	11.56	83.35
TET	Chlorothalonil	5.8	100	50	5	29	0.32	13.97	100.72

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
OXR	Oxyfluorfen	0.5	24	42	8	28	0.31	2.48	10.19
PRO	Prometryne	3.4	250	500	10	28	0.31	1.64	6.29
DCB	Dichlobenil	9		289	5	27	0.3	3.75	27.04
DOD	Dodine (dodecylguanidine monoacetate)	2.11	300	200	10	26	0.29	1.27	9.17
AMI	Amitrole	10.63	450	100	5	26	0.29	12.8	92.3
TRF	Trifluralin	2.02	5	5	3	24	0.27	48.56	350.09
PEN	Pendimethalin	1.09	1410	141	30	23	0.26	0.93	6.7
KRB	Propyzamide	2.25	protected		20	22	0.25	0.45	1.73
ENT	Endothall (form not specified)	1.36	250	50	7	22	0.24	3.29	23.69
MOM	Methamidophos	1.1	3	15	4	21	0.24	44.32	170.21
CAB	Carbaryl	9.8	3000	300	7	21	0.23	3.94	28.38
DUB	Chlorpyrifos	5	40	25	3	21	0.23	24.06	173.48
OXB	Oxamyl	2.24	50	50	4	20	0.22	5.41	38.97
PRT	Phosmet	1.88	60	60	3	20	0.22	3.76	27.13
BAX	Metribuzin	2.25	29	368	5	20	0.22	9.46	36.32
DIM	Dimethoate	2.4	4	30	3	19	0.22	72.27	277.52
TRI	Trichlorfon	3.2	9	27	3	19	0.21	42.82	164.45
CYM	Cypermethrin	0.95	50	50	5	19	0.21	2.29	16.49
ESF	Endosulfan	4.5	60	16	3	18	0.19	34.13	246.01
ATR	Atrazine	4	225	225	5	18	0.19	2.14	15.44
ACP	Acephate	2.55	20	5	2.5	17	0.19	61.43	442.82

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
ACA	Acifluorfen (form not specified)	0.6	20	100	5	16	0.18	3.61	13.88
TPM	Thiophanate-methyl	1.58	150	103	5	16	0.18	1.84	13.28
FOF	Fomesafen	0.24	50	46	8.6	16	0.17	0.63	4.53
CAF	Carbofuran	1.2	9	2	2	15	0.17	82.12	592
VIL	Vinclozolin	1	24	24	3	15	0.16	5.01	36.09
DPP	Diclofop-methyl	0.99	200	200	8	14	0.16	0.6	4.32
GOO	Azinphos-methyl	2.22	16	11	2	14	0.15	25.47	183.58
NAL	Naled	1.9	52	260	5	13	0.15	4.38	16.8
GPI	Glyphosate (isopropylamine salt)	4.32	275	30	2.5	13	0.14	17.34	125.03
MAN	Maneb	2.6	500	20	3	13	0.14	15.66	112.88
FLT	Flufenacet	0.8	441	88	8	12	0.13	1.09	7.89
MPR	(S)-Methoprene	0.24	16	16	3.4	12	0.13	1.8	13.01
MYC	Myclobutanil	0.14	60	60	15.9	11	0.12	0.27	1.97
FAD	Famoxadone	0.21	40	46	5.8	10	0.12	0.63	3.96
DIC	Dicamba (form not specified)	3.43	1600	800	9	10	0.11	0.52	3.72
CAP	Captan	12.5	1000	1000	2	9	0.1	1.51	10.85
BZN	Bentazon (form not specified)	1.08	40	24	2	9	0.1	5.41	38.98
IPD	Iprodione	1.5	300	300	5	9	0.1	0.6	4.34
AMZ	Amitraz	1.68	25	5	1	7	0.07	40.35	290.87
BTL	Desmedipham	0.71	450	90	5	7	0.07	0.95	6.87
IMI	Imidacloprid	0.31	126	28	3	6	0.07	1.33	9.58

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
CFZ	Clofentezine	0.3	30	270	5	6	0.07	1.2	4.63
MAL	Malathion	3.75	110	1200	3	5	0.05	4.11	15.77
TRR	Triforine	0.59	100	100	5	4	0.05	0.7	5.08
GLG	Glufosinate ammonium	1	400	400	4	3	0.04	0.3	2.17
MEI	Dimethenamid	1.68	360	1800	5.3	3	0.03	0.56	2.16
PIR	Pirimicarb	0.85	300	60	7	3	0.03	1.71	12.3
SOD	Sethoxydim	0.5	1000	42	3	2	0.03	1.41	10.17
MML	Methomyl	1.94	11	50	0.5	2	0.02	20.4	78.36
PYD	Pyridaben	0.54	1000	100	3	0	0	0.65	4.69
FOL	Folpet	5	1000	1000	3.4	0	0	0.6	4.34
DAZ	Dazomet	0.05	100	10	3.7	0	0	0.59	4.25
CYZ	Cyromazine	0.28	75	75	30	0	0	0.45	3.24
BRY	Bromoxynil (octanoate)	0.34	371	105	3	0	0	0.39	2.79
TFZ	Tebufenozide	0.29	100	1000	3	0	0	0.35	1.33
DXA	2,4-D (acid)	2.73	962		5	0	0	0.34	1.31
CYO	Cymoxanil	0.21	300	100	3.6	0	0	0.25	1.82
TER	Terbacil	3.6	4000	1800	30	0	0	0.24	1.74
NXI	Acetamiprid	0.17	89	125	4.9	0	0	0.23	1.17
CHH	Boscalid	0.54	300	1000	16.5	0	0	0.22	0.83
MAA	MCPA (acid)	1.75	1000		8	0	0	0.21	0.81
TEU	Tebuconazole	0.13	73	76	12.3	0	0	0.21	1.44
QTZ	Quintozene	1.69	1000	5500	4	0	0	0.2	0.78
AME	S-Metolachlor	1.6	1000		7	0	0	0.19	0.74
EFR	Ethalfluralin	1.4	1000	1000	4	0	0	0.17	1.22

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
TRA	Tralkoxydim	0.2	150	150	3.4	0	0	0.16	1.16
ETS	Ethofumesate	3.96	3240	3069	10	0	0	0.16	1.12
MER	Mesotrione	0.14	3000	120	5.9	0	0	0.14	1.04
DME	Dimethomorph	0.23	200		7.1	0	0	0.14	0.52
CNQ	Clomazone	1.12	1020		3	0	0	0.13	0.51
MEX	Tribenuron methyl	0.19	180	180	4	0	0	0.13	0.9
MMM	Thifensulfuron-methyl	1.24	1250	1250	3	0	0	0.12	0.86
PZN	Pymetrozine	0.1	100	100	9.2	0	0	0.12	0.84
CYP	Cyprodinil	0.56	600		5.8	0	0	0.11	0.43
TFS	Triflusulfuron methyl	0.04	125	40	3	0	0	0.11	0.76
FLZ	Fluazinam	0.16	200	350	6.7	0	0	0.1	0.4
CYH	Cyhalothrin-lambda	0.02	50	30	5	0	0	0.09	0.66
FBZ	Fenbuconazole (Indar)	0.11	150	300	18.6	0	0	0.08	0.32
PHY	Propamocarb hydrochloride	1.01	protected	protected	15	0	0	0.08	0.55
PMP	Phenmedipham	0.71	1200		5	0	0	0.07	0.27
FLR	Fluroxypyr 1-methylheptyl ester	0.14	1000	250	5.5	0	0	0.07	0.5
MXF	Methoxyfenozide	0.24	520	780	17	0	0	0.06	0.27
MEM	Metsulfuron-methyl	0.09	1000	200	30	0	0	0.05	0.39
KRS	Kresoxim-methyl	0.23	500	1000	4.1	0	0	0.05	0.21
FEX	Fenhexamid	0.85	2074		1.8	0	0	0.05	0.19
TFY	Trifloxystrobin	0.12	320	500	10.9	0	0	0.05	0.21
CLE	Clethodim	0.09	250	833	7	0	0	0.04	0.17

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
PSF	Prosulfuron	0.01		28	3	0	0	0.04	0.31
QUC	Quinclorac	0.12	500	1000	3	0	0	0.03	0.11
FLM	Flumetsulam	0.07	300	600	15.7	0	0	0.03	0.11
AZY	Azoxystrobin	0.28	1200	1200	3	0	0	0.03	0.2
ZOX	Zoxamide	0.22	1000	1000	4.5	0	0	0.03	0.19
PYA	Pyraclostrobin	0.23	1062	1062	7.5	0	0	0.03	0.18
IXF	Isoxaflutole	0.11	500		3	0	0	0.03	0.1
DPI	Clopyralid	0.2		protected	2	0	0	0.02	0.17
SPI	Spinosad	0.11	550	550	4.9	0	0	0.02	0.17
PON	Propiconazole	0.19	1000	1000	30	0	0	0.02	0.16
TPA	Tepraloxydim	0.05	350		10.9	0	0	0.02	0.07
CFP	Clodinafop-propargyl	0.07	500		1.7	0	0	0.02	0.06
FLS	Flucarbazone-sodium	0.03	1311	223	8	0	0	0.02	0.11
SLF	Sulfosulfuron	0.02	1250	250	11.9	0	0	0.01	0.07
CSL	Chlorsulfuron	0.01	166	987	30	0	0	0.01	0.03
FED	Fenamidone	0.1	1640	1614	11.3	0	0	0.01	0.05
TRT	Triticonazole	0.01	99	236	12.7	0	0	0.01	0.03
PRI	Primisulfuron-methyl	0.03	500	500	7	0	0	0.01	0.05
PFN	Picolinafen	0.05	protected	protected	9.1	0	0	0.01	0.05
CHE	Chlorimuron-ethyl	0.01	180	1080	15	0	0	0.01	0.02
DBR	Deltamethrin	0.02	450	450	3	0	0	0.01	0.04
FMS	Foramsulfuron	0.03	1000	1000	8.1	0	0	0	0.03
TRS	Triasulfuron	0.02	1000	1000	9.5	0	0	0	0.02
FLD	Fludioxonil	0	125	700	14.9	0	0	0	0.01

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
IMZ	Imazamox	0.03	2000	2000	3	0	0	0	0.01
DPY	Rimsulfuron	0.02	1250		3	0	0	0	0.01
HEC	Hexaconazole	0	250		14.3	0	0	0	0
FRA	Florasulam	0.01	protected	protected	4	0	0	0	0
IDO	Iodosulfuron-methyl-sodium	0		905	4.6	0	0	0	0
GPT	Glyphosate (trimethylsulfonium salt)	3.97	500	100	no data	no data	no data	4.78	34.47
DFF	Diflufenzopyr (form not specified)	0.06	1050	1050	no data	no data	no data	0.01	0.05
AMN	Aminoethoxyvinylglycine	0.13			no data	no data	no data	no data	no data
ASS	Imazamethabenz (form not specified)	0.5			18	no data	no data	no data	no data
AVG	Difenzoquat (methyl sulphate salt)	0.85			30	no data	no data	no data	no data
BAD	6-Benzyladenine	0.08			11.7	no data	no data	no data	no data
BMS	Flusilazole	0.04			14.8	no data	no data	no data	no data
CCC	Chlormequat (form not specified)	1.38			6.4	no data	no data	no data	no data
CHL	Chlorthal (form not specified)	13.5			10	no data	no data	no data	no data
CLM	Cloransulam (form not specified)	0.04			6.7	no data	no data	no data	no data

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
CUS	Copper (copper sulphate)	0.01			7	no data	no data	no data	no data
CUY	Copper (copper oxychloride)	4.5			no data	no data	no data	no data	no data
DIH	Dichlorprop (form not specified)	0.53			9	no data	no data	no data	no data
DIK	Dichloran	33			4	no data	no data	no data	no data
DIN	Dinocap	0.32			8	no data	no data	no data	no data
DPA	Diphenylamine	2.05			1.3	no data	no data	no data	no data
DPB	2,4-DB (form not specified)	1.72			5	no data	no data	no data	no data
DXB	2,4-D (unspecified amine salt)	2.76			9	no data	no data	no data	no data
DXF	2,4-D (unspecified ester)	3.14			5	no data	no data	no data	no data
DYR	Anilazine	3.38			1	no data	no data	no data	no data
EPT	EPTC	6.8			3	no data	no data	no data	no data
ETF	Ethephon	3.36			5	no data	no data	no data	no data
ETM	Ethametsulfuron (form not specified)	0.02			15.5	no data	no data	no data	no data
FAA	N-Decanol	14.44			2.1	no data	no data	no data	no data
FAB	N-Octanol	16.08			1.1	no data	no data	no data	no data
FAL	Fosetyl-al	4.48			0.1	no data	no data	no data	no data
FER	Ferbam	6.27			3	no data	no data	no data	no data
FOR	Formaldehyde	1.19			2.2	no data	no data	no data	no data
FPF	Fenoxaprop-p-ethyl	0.1			5.6	no data	no data	no data	no data

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
FZA	Fluazifop-p-butyl	0.25			4	no data	no data	no data	no data
GPM	Glyphosate (mono-ammonium salt)	4.35			no data	no data	no data	no data	no data
GPP	Glyphosate (potassium salt)	4.32			no data	no data	no data	no data	no data
GPS	Glyphosate (acid)	4.95			3	no data	no data	no data	no data
IMP	Imazethapyr	0.95			30	no data	no data	no data	no data
MAB	MCPA (dimethylammine salt)	2.38			7	no data	no data	no data	no data
MAE	MCPA (unspecified ester)	1.75			8	no data	no data	no data	no data
MAH	Maleic hydrazide (form not specified)	3.39			10	no data	no data	no data	no data
MAS	MCPA (potassium salt)	2.7			no data	no data	no data	no data	no data
MBS	MCPB (sodium salt)	1.7			7	no data	no data	no data	no data
MEA	Mecoprop (potassium salt)	1.16			no data	no data	no data	no data	no data
MEC	Mecoprop (form not specified)	0.85			10	no data	no data	no data	no data
MET	Methoxychlor	2.7			6	no data	no data	no data	no data
MEW	Mecoprop d-isomer (potassium salt)	1.05			no data	no data	no data	no data	no data
MEZ	Mecoprop d-isomer (amine salt)	0.85			2.7	no data	no data	no data	no data
MFN	Metalaxyl-m (mefenoxam)	1.11			3.7	no data	no data	no data	no data

Table 10: Avian reproductive risk scores for foliar liquid applications.

AI Code	AI Accepted Name	Maximum Application rate (kg ai per hectare)	Bobwhite min NOAEC in standard study	Mallard min NOAEC in standard study	Foliar DT50 FINAL CHOICE	Standardised days above exceedance (Tc)	Proportion of typical 90 day breeding season	EPA Chronic RQ	PMRA RQ
NAA	1-Naphthalene actetic acid (form not specified)	0			5	no data	no data	no data	no data
NAD	Naphthaleneacetamide	0.17			5	no data	no data	no data	no data
NAP	Naptalam (form not specified)	7.2			7	no data	no data	no data	no data
NIO	Nicosulfuron	0.03			5	no data	no data	no data	no data
PAQ	Paraquat (form not specified)	1.5			30	no data	no data	no data	no data
PHS	Phosalone	0.63			8	no data	no data	no data	no data
PIC	Picloram (form not specified)	2.16			8	no data	no data	no data	no data
PID	Picloram (triisopropanolamine salt)	0.02			8	no data	no data	no data	no data
PYR	Pyrethrins	0.01			10	no data	no data	no data	no data
PYZ	Pyrazon (chloridazon)	4.41			5	no data	no data	no data	no data
QPE	Quizalofop p-ethyl	0.07			6.3	no data	no data	no data	no data
SUL	Sulphur	18			23.1	no data	no data	no data	no data
TCM	2-(Thiocyanomethylthio)benzothiazole	0.07			2	no data	no data	no data	no data
ZIN	Zineb	2.64			5	no data	no data	no data	no data
ZIR	Ziram	6.8			5	no data	no data	no data	no data

7 AVIAN REPRODUCTIVE RISK SCORES FOR GRANULAR PESTICIDES.

Like seeds, one difficulty with the approach adopted for spray applications is that the rate of disappearance of treated granules is more complex than the first order loss rates assumed for sprayed residues on surfaces. We, therefore, reverted to calculating only the number of particles needed to exceed the daily critical intake deemed to be above a reproductive threshold for a 15 g songbird, using reproductive study endpoints instead of acute toxicity.

No standards were set because of the high uncertainty surrounding the continued availability of granules after application.

Table 11: Avian reproductive risk scores for granular pesticides.

AI Code	AI Accepted Name	% Guarantee	Granule size (g)	Bobwhite min NOEL lab mash	Mallard min NOEL lab mash	Critical intake level Ic (ug/15 g bird/day)	Risk as number of particles to reach critical daily intake	Relative risk unadjusted for differential granule base
COY	Terbufos	15.00	0.0002	30	2	0.44	0.01	1.00
DAZ	Dazomet	97.00	0.0002	100	10	6.67	0.03	1.00
TRF	Trifluralin	10.00	0.0002	5	5	1.05	0.05	1.00
TRF	Trifluralin	5.00	0.0002	5	5	1.05	0.11	1.00
PHR	Phorate	15.00	0.0002	60	5	3.32	0.11	1.00
TRF	Trifluralin	4.00	0.0002	5	5	1.05	0.13	1.00
TRF	Trifluralin	3.00	0.0002	5	5	1.05	0.18	1.00
DIA	Diazinon	5.00	0.0002	32	6	1.77	0.18	1.00

Table 11: Avian reproductive risk scores for granular pesticides.

AI Code	AI Accepted Name	% Guarantee	Granule size (g)	Bobwhite min NOEL lab mash	Mallard min NOEL lab mash	Critical intake level Ic (ug/15 g bird/day)	Risk as number of particles to reach critical daily intake	Relative risk unadjusted for differential granule base
DUB	Chlorpyrifos	15.00	0.0002	40	25	6.33	0.21	1.00
TEL	Tefluthrin	3.00	0.0002	25	25	5.27	0.88	1.00
TRL	Triallate	10.00	0.0002	200		51.56	2.58	0.39
NBP	Napropamide	10.00	0.0002		1000	172.71	8.64	0.12
MTA	Metalaxyl	2.00	0.0002	300	100	36.55	9.14	0.11
MTA	Metalaxyl	1.00	0.0002	300	100	36.55	18.27	0.05
CAB	Carbaryl	5.00	0.0002	3000	300	187.26	18.73	0.05
EFR	Ethalfluralin	5.00	0.0002	1000	1000	211.00	21.10	0.05
EPT	EPTC	5.00	0.0002	no data	no data	no data	no data	no data
EPT	EPTC	10.00	0.0002	no data	no data	no data	no data	no data
EPT	EPTC	25.00	0.0002	no data	no data	no data	no data	no data
MFN	Metalaxyl-m (mefenoxam)	1.00	0.0002	no data	no data	no data	no data	no data

8 AVIAN REPRODUCTIVE RISK SCORES FOR SEED TREATMENT PESTICIDES.

Like granules, one difficulty with the approach adopted for spray applications is that the rate of disappearance of treated seed is more complex than the first order loss rates assumed for sprayed residues on surfaces. We, therefore, reverted to calculating only the number of particles needed to

exceed the daily critical intake deemed to be above a reproductive threshold for a 15 g songbird, using reproductive study endpoints instead of acute toxicity.

No standards were set because of the high uncertainty surrounding the continued availability of seeds after application.

Our risk scores are compared to USEPA and PMRA risk quotients in the following table. The level of concern for chronic risk in both jurisdictions is 1. To aid visualisation, RQs above 1 are red, and below 1 are green.

Perhaps not surprisingly given the high loading of active ingredients per granule or seed, a large number of registered products are expected to deliver an exposure level that is above the estimated daily reproductive critical dose in a single particle or less. Unfortunately, there are no field studies available to validate this high predicted risk. For several of the products, the occurrence of reproductive effects is likely to be a moot point given that a single particle is also likely to be lethal. From a scoring point of view, our proposed method has the drawback of not being able to distinguish between the relative risks of several of the registered seed treatments, because all particles expected to deliver an exposure level that is above the estimated daily reproductive critical dose in a single particle or less were given a score of 1. Setting the maximum risk level at one seed per day should perhaps be revisited in order for the risk scores to be more informative.

Table 12: Avian reproductive risk scores for seed treatment pesticides.

AI Code	AI Accepted Name	Type of seed treated	Bobwhite min NOEC DW	Mallard min NOEC DW	Critical intake level Ic (ug/15 g bird/day)	Risk (No. Seeds to critical intake)	Relative risk score	Correction factor to reflect relative seed attractiveness	Relative risk score corrected for seed attractiveness	USEPA RQ	PMRA RQ
IMI	Imidacloprid	Canola	126.0	28.3	10.5	0.44	1.00	0.20	1.00	282.35	994.21
THI	Thiram	Canola	500.0	9.6	18.0	0.91	1.00	0.20	1.00	210.52	2404.01
MAN	Maneb	Cereal	500.0	20.0	21.1	0.28	1.00	2.00	1.00	88.15	420.64
THI	Thiram	Cereal	500.0	9.6	18.0	0.74	1.00	2.00	1.00	67.60	286.62
TEU	Tebuconazole	Cereal	73.0	75.8	30.2	0.51	1.00	2.00	1.00	21.88	87.92
VIT	Carbathiin	Cereal	1000.0	70.0	19.5	0.13	1.00	2.00	1.00	17.73	243.40
VIT	Carbathiin	Corn	1000.0	70.0	64.9	0.14	1.00	2.00	1.00	1053.13	62.44
DIA	Diazinon	Corn	32.0	6.0	5.9	0.04	1.00	2.00	1.00	273.67	219.18
THI	Thiram	Corn	500.0	9.6	60.0	0.09	1.00	2.00	1.00	171.56	661.76
IMI	Imidacloprid	Corn	126.0	28.3	35.1	0.04	1.00	2.00	1.00	88.08	310.33
MTA	Metalaxyl	Corn	300.0	100.0	121.8	0.15	1.00	2.00	1.00	19.80	73.25
MCZ	Mancozeb	Corn	125.0	125.0	87.9	0.13	1.00	2.00	1.00	14.06	49.51
COD	Clothianidin	Corn	205.0	525.0	230.7	0.38	1.00	2.00	1.00	12.81	14.43
TPM	Thiophanate-methyl	Corn	150.0	103.0	87.4	0.33	1.00	2.00	1.00	6.79	23.90
CAP	Captan	Corn	1000.0	1000.0	247.7	0.11	1.00	2.00	1.00	5.84	20.57
THE	Thiamethoxam	Corn	900.0	300.0	365.5	0.94	1.00	2.00	1.00	2.65	12.04
DFZ	Difenoconazole	Corn	125.0	125.0	87.9	0.96	1.00	2.00	1.00	1.56	6.78
TLL	Triadimenol	Cereal		100.0	17.3	1.47	0.68	2.00	1.00	3.19	13.32
MTA	Metalaxyl	Cereal	300.0	100.0	36.5	2.82	0.35	2.00	0.71	3.51	14.66

Table 12: Avian reproductive risk scores for seed treatment pesticides.

AI Code	AI Accepted Name	Type of seed treated	Bobwhite min NOEC DW	Mallard min NOEC DW	Critical intake level Ic (ug/15 g bird/day)	Risk (No. Seeds to critical intake)	Relative risk score	Correction factor to reflect relative seed attractiveness	Relative risk score corrected for seed attractiveness	USEPA RQ	PMRA RQ
DFZ	Difenoconazole	Cereal	125.0	125.0	26.4	3.13	0.32	2.00	0.64	1.56	7.64
THE	Thiamethoxam	Cereal	900.0	300.0	109.6	9.37	0.11	2.00	0.21	10.48	4.42
FLD	Fludioxonil	Corn	125.0	700.0	208.0	9.80	0.10	2.00	0.20	0.37	0.84
TRT	Triticonazole	Cereal	99.3	236.0	32.3	17.25	0.06	2.00	0.12	0.60	1.14
NXI	Acetamiprid	Canola	89.0	125.0	22.3	2.94	0.34	0.20	0.07	28.24	70.86
FLD	Fludioxonil	Cereal	125.0	700.0	62.4	34.88	0.03	2.00	0.06	0.34	0.86
VIT	Carbathiin	Canola	1000.0	70.0	19.5	6.49	0.15	0.20	0.03	14.97	50.19
IPD	Iprodione	Canola	300.0	300.0	63.3	7.10	0.14	0.20	0.03	9.73	34.80
COD	Clothianidin	Canola	205.0	525.0	69.2	7.22	0.14	0.20	0.03	15.57	29.20
THE	Thiamethoxam	Canola	900.0	300.0	109.6	9.05	0.11	0.20	0.02	0.86	47.29
MTA	Metalaxyl	Canola	300.0	100.0	36.5	32.96	0.03	0.20	0.01	3.51	12.99
DFZ	Difenoconazole	Canola	125.0	125.0	26.4	42.63	0.02	0.20	0.00	1.20	5.80
FLD	Fludioxonil	Canola	125.0	700.0	62.4	406.88	0.00	0.20	0.00	0.34	0.77
MFN	Metalaxyl-m (mefenoxam)	Canola	na	na	no data	no data	no data	0.20	no data	no data	no data
MFN	Metalaxyl-m (mefenoxam)	Cereal	na	na	no data	no data	no data	2.00	no data	no data	no data
MFN	Metalaxyl-m (mefenoxam)	Corn	na	na	no data	no data	no data	2.00	no data	no data	no data

9 RISK SCORES FOR SMALL MAMMAL POPULATION IMPACTS.

Acute risk quotients for small mammal populations were computed based on previous EU guidance (European Commission, 2002; details given in Appendix B), although risk quotients were expressed as North American-styled risk quotients (ETRs – or exposure over toxicity rather than TERs – toxicity over exposure) and log transformed.

The table shows how each of the registered active ingredients fared when applied at maximum label rate. Rates are the same as in the table in Section 2. We calculated the probability of impact of residues in the environment on small mammal populations. As with the bird acute index for spray applications, we computed current EPA and PMRA risk quotients for comparison purposes (shown in Table 13). To help visualize the results we used red highlighting for EPA RQs above 0.5, yellow between 0.2 and 0.5, and green below 0.2. Canadian RQ>1 are in red, those below are in green.

One observation is that there is less agreement between our results and the USEPA and PMRA's results for small mammals, than there was for birds. USEPA and PMRA have different ways of computing RQs, which leads to significant variations in how different applications are assessed. Also, both agencies rely solely on rat data, which (counter-intuitively) we have found to be a poor predictor of small mammal toxicity. The PMRA's level of concern (LOC) of 1 corresponds almost exactly to our calculation of a '*de minimis*' risk for small mammal populations. This, therefore, appears reasonable as a screening assessment.

The USEPA is less protective in its method of assessment and LOC. Adopting the PMRA's LOC of 1 (less than a 1% risk based on our estimate) would mean that approximately 37% of assessed products (when applied at maximum label rate) are above the LOC. The probability of impact

based on our model is approximately 75%. Based on their respective methodologies, both USEPA and PMRA would agree that most of these applications pose a very high risk.

We propose that all applications scoring above this level (i.e., with a probability of impact of 75% or more) should be red-listed, and actions should be taken as soon as possible to minimise them and reduce mammal impacts. The standard itself should be set at a more protective level to minimise the proportion of pesticide applications that can impact small mammal populations.

Below the predicted probability of impact of 10%, there are no EPA RQs that exceed the highest USEPA acute level of concern. We propose this be the established standard for small mammals but recognise that it may be considered too protective.

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
FOM	Formetanate (form not specified)	222	1.00	191.24	16.57
CUZ	Copper (copper hydroxide)	182	1.00	4.22	0.37
PAQ	Paraquat (form not specified)	132	1.00	9.67	0.84
BET	Bensulide	109	1.00	22.83	1.98
DIQ	Diquat (form not specified)	86	1.00	4.38	0.38
ETS	Ethofumesate	70	1.00	0.73	0.06
AVG	Difenzoquat (methyl sulphate salt)	69	1.00	2.09	0.18
THI	Thiram	43	0.99	10.58	0.92
OXB	Oxamyl	34	0.98	823.23	71.33
SUL	Sulphur	34	0.98	3.30	0.29
ENT	Endothall (form not specified)	31	0.98	27.62	2.39
CCC	Chlormequat (form not specified)	30	0.97	1.57	0.14
LUN	Linuron	29	0.97	1.68	0.15
CAB	Carbaryl	27	0.96	17.98	1.56
ESF	Endosulfan	25	0.96	58.96	5.11
TPR	Triclopyr	24	0.95	6.10	0.53

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
DIA	Diazinon	22	0.94	8.51	0.74
MOM	Methamidophos	21	0.94	77.89	6.75
ZIR	Ziram	20	0.93	3.02	0.26
PIR	Pirimicarb	17	0.89	5.49	0.48
DOD	Dodine (dodecylguanidine monoacetate)	16	0.88	1.94	0.17
NAP	Naptalam (form not specified)	15	0.86	3.73	0.32
NAL	Naled	14	0.84	4.05	0.35
DIK	Dichloran	14	0.84	7.49	0.65
GOO	Azinphos-methyl	13	0.80	226.23	19.60
CAF	Carbofuran	13	0.80	137.57	11.92
DUB	Chlorpyrifos	12	0.80	30.88	2.68
PRT	Phosmet	12	0.80	15.22	1.32
PHS	Phosalone	12	0.77	4.78	0.41
VPR	Hexazinone	11	0.75	1.10	0.10
TER	Terbacil	11	0.74	3.54	0.31
DXA	2,4-D (acid)	10	0.72	6.67	0.58
DCB	Dichlobenil	10	0.69	1.85	0.16
MAB	MCPA (dimethylammine salt)	9	0.66	data gap	data gap
DUR	Diuron	9	0.63	1.46	0.13
DXF	2,4-D (unspecified ester)	9	0.63	4.64	0.40
TRI	Trichlorfon	8	0.56	11.74	1.02
MAA	MCPA (acid)	7	0.50	1.78	0.15
DIM	Dimethoate	7	0.50	5.69	0.49
MBS	MCPB (sodium salt)	6	0.46	2.26	0.20
BAX	Metribuzin	6	0.43	1.03	0.09
PRO	Prometryne	6	0.41	1.56	0.14
DIC	Dicamba (form not specified)	6	0.37	1.84	0.16
FOR	Formaldehyde	5	0.33	1.64	0.14
ACP	Acephate	5	0.33	3.34	0.29
PFL	Permethrin	5	0.29	1.75	0.15
ATR	Atrazine	4	0.23	1.53	0.13

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
PYZ	Pyrazon (chloridazon)	4	0.21	1.89	0.16
EPT	EPTC	4	0.20	3.12	0.27
DPB	2,4-DB (form not specified)	4	0.19	3.10	0.27
TRL	Triallate	4	0.18	1.84	0.16
MML	Methomyl	3	0.12	59.16	5.13
MAL	Malathion	2	0.10	1.75	0.15
DCF	Dicofol	2	0.09	4.05	0.35
MFN	Metalaxyl-m (mefenoxam)	2	0.05	1.53	0.13
GLG	Glufosinate ammonium	1	0.04	0.57	0.05
FER	Ferbam	1	0.04	1.44	0.12
CYM	Cypermethrin	1	0.04	0.86	0.07
DYR	Anilazine	1	0.03	1.14	0.10
DPA	Diphenylamine	1	0.02	3.43	0.30
BRY	Bromoxynil (octanoate)	1	0.02	1.63	0.14
AMI	Amitrole	1	0.02	1.87	0.16
CAP	Captan	1	0.01	1.27	0.11
AMZ	Amitraz	0	0.01	2.36	0.20
SMZ	Simazine	0	0.01	2.21	0.19
NAA	1-Naphthalene actetic acid (form not specified)	0	0.00	0.00	0.00
FLD	Fludioxonil	0	0.00	0.00	0.00
IDO	Iodosulfuron-methyl-sodium	0	0.00	0.00	0.00
FRA	Florasulam	0	0.00	0.00	0.00
HEC	Hexaconazole	0	0.00	0.00	0.00
CSL	Chlorsulfuron	0	0.00	0.00	0.00
ETM	Ethametsulfuron (form not specified)	0	0.00	0.00	0.00
CHE	Chlorimuron-ethyl	0	0.00	0.00	0.00
DPY	Rimsulfuron	0	0.00	0.00	0.00
TRT	Triticonazole	0	0.00	0.00	0.00
SLF	Sulfosulfuron	0	0.00	0.00	0.00
TRS	Triasulfuron	0	0.00	0.00	0.00

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
NIO	Nicosulfuron	0	0.00	0.00	0.00
IMZ	Imazamox	0	0.00	0.00	0.00
FLS	Flucarbazone-sodium	0	0.00	0.01	0.00
PRI	Primisulfuron-methyl	0	0.00	0.01	0.00
FMS	Foramsulfuron	0	0.00	0.01	0.00
TFS	Triflusulfuron methyl	0	0.00	0.01	0.00
CLM	Cloransulam (form not specified)	0	0.00	0.01	0.00
PYR	Pyrethrins	0	0.00	0.01	0.00
TPA	Tepraloxydim	0	0.00	0.01	0.00
PFN	Picolinafen	0	0.00	0.01	0.00
PSF	Prosulfuron	0	0.00	0.01	0.00
FLM	Flumetsulam	0	0.00	0.01	0.00
PZN	Pymetrozine	0	0.00	0.02	0.00
MEM	Metsulfuron-methyl	0	0.00	0.02	0.00
IXF	Isoxaflutole	0	0.00	0.02	0.00
DBR	Deltamethrin	0	0.00	0.02	0.00
TFY	Trifloxystrobin	0	0.00	0.02	0.00
SPI	Spinosad	0	0.00	0.03	0.00
FPF	Fenoxaprop-p-ethyl	0	0.00	0.03	0.00
FLR	Fluroxypyr 1-methylheptyl ester	0	0.00	0.03	0.00
MER	Mesotrione	0	0.00	0.03	0.00
FLZ	Fluazinam	0	0.00	0.03	0.00
BAD	6-Benzyladenine	0	0.00	0.03	0.00
TRR	Triforine	0	0.00	0.03	0.00
MEX	Tribenuron methyl	0	0.00	0.03	0.00
CFP	Clodinafop-propargyl	0	0.00	0.03	0.00
FAD	Famoxadone	0	0.00	0.04	0.00
ZOX	Zoxamide	0	0.00	0.04	0.00
KRS	Kresoxim-methyl	0	0.00	0.04	0.00
PYA	Pyraclostrobin	0	0.00	0.04	0.00
QUC	Quinclorac	0	0.00	0.04	0.00

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
MPR	(S)-Methoprene	0	0.00	0.04	0.00
MXF	Methoxyfenozide	0	0.00	0.04	0.00
FED	Fenamidone	0	0.00	0.05	0.00
AZY	Azoxystrobin	0	0.00	0.05	0.00
TFZ	Tebufenozide	0	0.00	0.05	0.00
CFZ	Clofentezine	0	0.00	0.05	0.00
BMS	Flusilazole	0	0.00	0.05	0.00
DME	Dimethomorph	0	0.00	0.06	0.01
VIL	Vinclozolin	0	0.00	0.06	0.01
CLE	Clethodim	0	0.00	0.06	0.01
BTL	Desmedipham	0	0.00	0.06	0.01
TEU	Tebuconazole	0	0.00	0.07	0.01
DPI	Clopyralid	0	0.00	0.07	0.01
CYZ	Cyromazine	0	0.00	0.08	0.01
MYC	Myclobutanil	0	0.00	0.08	0.01
PMP	Phenmedipham	0	0.00	0.08	0.01
OXR	Oxyfluorfen	0	0.00	0.09	0.01
ASS	Imazamethabenz (form not specified)	0	0.00	0.09	0.01
FZA	Fluazifop-p-butyl	0	0.00	0.09	0.01
PON	Propiconazole	0	0.00	0.11	0.01
FOF	Fomesafen	0	0.00	0.14	0.01
FEX	Fenhexamid	0	0.00	0.16	0.01
SOD	Sethoxydim	0	0.00	0.17	0.01
IMP	Imazethapyr	0	0.00	0.17	0.02
TRA	Tralkoxydim	0	0.00	0.20	0.02
CYO	Cymoxanil	0	0.00	0.20	0.02
TPM	Thiophanate-methyl	0	0.00	0.22	0.02
MMM	Thifensulfuron-methyl	0	0.00	0.23	0.02
EFR	Ethalfluralin	0	0.00	0.26	0.02
CYP	Cyprodinil	0	0.00	0.26	0.02
TZL	Thiabendazole	0	0.00	0.30	0.03

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
QTZ	Quintozene	0	0.00	0.31	0.03
ACA	Acifluorfen (form not specified)	0	0.00	0.36	0.03
KRB	Propyzamide	0	0.00	0.37	0.03
TRF	Trifluralin	0	0.00	0.37	0.03
CYH	Cyhalothrin-lambda	0	0.00	0.38	0.03
PHY	Propamocarb hydrochloride	0	0.00	0.39	0.03
PIC	Picloram (form not specified)	0	0.00	0.40	0.03
MOR	Chinomethionat	0	0.00	0.42	0.04
MTR	Metiram	0	0.00	0.44	0.04
ZIN	Zineb	0	0.00	0.47	0.04
MAN	Maneb	0	0.00	0.48	0.04
FOL	Folpet	0	0.00	0.51	0.04
AME	S-Metolachlor	0	0.00	0.55	0.05
PYD	Pyridaben	0	0.00	0.60	0.05
MAH	Maleic hydrazide (form not specified)	0	0.00	0.62	0.05
IMI	Imidacloprid	0	0.00	0.64	0.06
IPD	Iprodione	0	0.00	0.69	0.06
MTL	Metolachlor	0	0.00	0.71	0.06
FAA	N-Decanol	0	0.00	0.74	0.06
CNQ	Clomazone	0	0.00	0.75	0.06
GPI	Glyphosate (isopropylamine salt)	0	0.00	0.79	0.07
GPS	Glyphosate (acid)	0	0.00	0.81	0.07
PEN	Pendimethalin	0	0.00	0.95	0.08
MEI	Dimethenamid	0	0.00	0.98	0.09
BZN	Bentazon (form not specified)	0	0.00	0.99	0.09
CHL	Chlorthal (form not specified)	0	0.00	0.99	0.09
ETF	Ethephon	0	0.00	1.02	0.09
NXI	Acetamiprid	0	0.00	1.06	0.09
TET	Chlorothalonil	0	0.00	1.06	0.09
FLT	Flufenacet	0	0.00	1.25	0.11
NBP	Napropamide	0	0.00	1.31	0.11

Table 13: Risk scores for small mammal population impacts.

AI Code	AI Accepted Name	Time (days) for residues to drop below critical level	Modeled probability of small mammal population impact	PMRA RQ	USEPA RQ
MCZ	Mancozeb	0	0.00	1.32	0.11
DPP	Diclofop-methyl	0	0.00	1.58	0.14
FAL	Fosetyl-al	0	0.00	2.05	0.18
NAD	Naphthaleneacetamide	0	0.00	data gap	data gap
PID	Picloram (triisopropanolamine salt)	0	0.00	data gap	data gap
QPE	Quizalofop p-ethyl	0	0.00	data gap	data gap
DFF	Diflufenzopyr (form not specified)	data gap	data gap	10.46	0.91
CUY	Copper (copper oxychloride)	data gap	data gap	5.52	0.48
GPT	Glyphosate (trimethylsulfonium salt)	data gap	data gap	4.87	0.42
DIN	Dinocap	data gap	data gap	0.30	0.03
AMN	Aminoethoxyvinylglycine	data gap	data gap	0.02	0.00
CHH	Boscalid	data gap	data gap	data gap	data gap
CUS	Copper (copper sulphate)	data gap	data gap	data gap	data gap
DIH	Dichlorprop (form not specified)	data gap	data gap	data gap	data gap
DXB	2,4-D (unspecified amine salt)	data gap	data gap	data gap	data gap
FAB	N-Octanol	data gap	data gap	data gap	data gap
FBZ	Fenbuconazole	data gap	data gap	data gap	data gap
GPM	Glyphosate (mono-ammonium salt)	data gap	data gap	data gap	data gap
GPP	Glyphosate (potassium salt)	data gap	data gap	data gap	data gap
MAE	MCPA (unspecified ester)	data gap	data gap	data gap	data gap
MAS	MCPA (potassium salt)	data gap	data gap	data gap	data gap
MEA	Mecoprop (potassium salt)	data gap	data gap	data gap	data gap
MEC	Mecoprop (form not specified)	data gap	data gap	data gap	data gap
MEW	Mecoprop d-isomer (potassium salt)	data gap	data gap	data gap	data gap
MEZ	Mecoprop d-isomer (amine salt)	data gap	data gap	data gap	data gap
TCM	2-(Thiocyanomethylthio)benzothiazole	data gap	data gap	data gap	data gap

10 MAMMALIAN ACUTE RISK SCORES FOR SEED-TREATMENT PESTICIDES.

The following table (Table 14) ranks the risk to a 25 g small mammal at the 5% tail of the species sensitivity distribution to mammals. In order to 'anchor' the relative risk scores in the same way as was done for birds, we assumed that the worst outcome would be the situation where a single seed is above the lethal dose. No products reached that level of toxicity for small mammals. The standard here again was provisionally set at 0.1 as it was in birds. Without any modification for relative attractiveness (i.e., all UPAFs set at 1), this is equivalent to consumption of 10 seeds.

Table 14: Mammalian acute risk scores for seed-treatment pesticides.

AI Code	AI Accepted Name	Type of seed treated	HC5 Mammals (oral) (mg/kg)	Maximum Rate AI (mg/seed)	mammal body weight (g)	Risk as the number of seeds to HD5	Relative risk
IMI	Imidacloprid	Corn	65.73	0.948	25	1.7	0.58
THI	Thiram	Corn	142.55	0.687	25	5.2	0.19
DIA	Diazinon	Corn	50.13	0.142	25	8.8	0.11
MTA	Metalaxyl	Corn	323.05	0.792	25	10	0.10
CAP	Captan	Corn	2053.37	2.220	25	23	0.04
THE	Thiamethoxam	Corn	399.77	0.390	25	26	0.04
VIT	Carbathiin	Corn	876.45	0.472	25	46	0.02
COD	Clothianidin	Corn	1279.00	0.600	25	53	0.02
MCZ	Mancozeb	Corn	1638.54	0.669	25	61	0.02
IMI	Imidacloprid	Canola	65.73	0.024	25	68	0.01
MFN	Metalaxyl-m (mefenoxam)	Corn	158.59	0.054	25	74	0.01
TPM	Thiophanate-methyl	Corn	979.87	0.266	25	92	0.01
DFZ	Difenoconazole	Corn	436.02	0.092	25	119	0.01
VIT	Carbathiin	Cereal	876.45	0.150	25	146	0.01

Table 14: Mammalian acute risk scores for seed-treatment pesticides.

AI Code	AI Accepted Name	Type of seed treated	HC5 Mammals (oral) (mg/kg)	Maximum Rate AI (mg/seed)	mammal body weight (g)	Risk as the number of seeds to HD5	Relative risk
THI	Thiram	Cereal	142.55	0.024	25	147	0.01
TEU	Tebuconazole	Cereal	361.71	0.059	25	154	0.01
NXI	Acetamiprid	Canola	47.14	0.008	25	156	0.01
THI	Thiram	Canola	142.55	0.020	25	181	0.01
MAN	Maneb	Cereal	1413.45	0.074	25	476	0.00
TLL	Triadimenol	Cereal	286.76	0.012	25	610	0.00
MTA	Metalaxyl	Cereal	323.05	0.013	25	624	0.00
MFN	Metalaxyl-m (mefenoxam)	Cereal	158.59	0.005	25	802	0.00
THE	Thiamethoxam	Canola	399.77	0.012	25	825	0.00
THE	Thiamethoxam	Cereal	399.77	0.012	25	854	0.00
DFZ	Difenoconazole	Cereal	436.02	0.008	25	1293	0.00
FLD	Fludioxonil	Corn	1278.86	0.021	25	1506	0.00
IPD	Iprodione	Canola	957.01	0.009	25	2685	0.00
COD	Clothianidin	Canola	1279.00	0.010	25	3334	0.00
TRT	Triticonazole	Cereal	511.55	0.002	25	6830	0.00
MTA	Metalaxyl	Canola	323.05	0.001	25	7283	0.00
VIT	Carbathiin	Canola	876.45	0.003	25	7307	0.00
MFN	Metalaxyl-m (mefenoxam)	Canola	158.59	0.000	25	9360	0.00
DFZ	Difenoconazole	Canola	436.02	0.001	25	17617	0.00
FLD	Fludioxonil	Cereal	1278.86	0.002	25	17865	0.00
FLD	Fludioxonil	Canola	1278.86	0.000	25	208422	0.00

11 MAMMALIAN ACUTE RISK SCORES FOR GRANULAR PRODUCTS.

An identical strategy was followed for granular products as it was for seed treatments. The relative risks are ranked according to their risk to a 20 g small mammal at the 5% tail of the species sensitivity distribution to mammals. We assumed that the worst outcome would be the situation where a single seed is above the lethal dose. Obviously, granules will not be taken up as grit by small mammals. However, some are on an organic base (e.g., corn cob); others use vegetable oil as carrier and may, therefore, have some food value and be attractive to a foraging small mammal.

The standard is provisionally set at the same level as for seed treatments – or 0.1. Only two products (terbufos and phorate) exceed this standard and are toxic enough to be red-listed.

Table 15: Mammalian acute risk scores for granular products.

AI Code	Pesticide	% guarantee	HD5 (mg/kg)	Risk (No. Granules to HD5 for 25 g mammal)	Relative risk
COY	Terbufos	15%	0.74	0.62	1.00
PHR	Phorate	15%	0.86	0.71	1.00
DAZ	Dazomet	97%	128.83	17	0.06
TEL	Tefluthrin	3%	9.60	40	0.03
DUB	Chlorpyrifos	15%	55.18	46	0.02
DIA	Diazinon	5%	50.13	125	0.01
EPT	EPTC	25%	559.82	280	0.00
MTA	Metalaxyl	2%	47.93	300	0.00
CAB	Carbaryl	5%	139.65	349	0.00
TRL	Triallate	10%	370.18	463	0.00
MTA	Metalaxyl	1%	47.93	599	0.00
EPT	EPTC	10%	559.82	700	0.00
TRF	Trifluralin	10%	1017.00	1271	0.00

Table 15: Mammalian acute risk scores for granular products.

AI Code	Pesticide	% guarantee	HD5 (mg/kg)	Risk (No. Granules to HD5 for 25 g mammal)	Relative risk
EPT	EPTC	5%	559.82	1400	0.00
NBP	Napropamide	10%	1464.00	1830	0.00
TRF	Trifluralin	5%	1017.00	2543	0.00
TRF	Trifluralin	4%	1017.00	3178	0.00
EFR	Ethalfluralin	5%	1279.00	3198	0.00
TRF	Trifluralin	3%	1017.00	4238	0.00
MFN	Metalaxyl-m (mefenoxam)	1%	1111.00	13888	0.00

12 BEE HAZARD RATIOS FOR 206 PESTICIDES USED ON CROPS IN CANADA LISTED WITH THEIR ASSOCIATED BEE CONTACT LD_{50} VALUE AND MAXIMUM APPLICATION RATE (G AI/HA).

There appears to be negligible risk from applications of pesticides with $HR_{contact}$ values below 50. This is a useful validation of the first Tier cut-off value of 50 proposed in the European Commission Guidance Document on Terrestrial Ecotoxicology (European Commission, 2002), which was apparently established from unpublished field trials. Beyond a $HR_{contact}$ value of 400, the risk of recording hive mortality incidents is extreme (~ 50% probability) for any pesticide in broad usage. It is clear that the lack of any mortality incident data is no grounds to declare a product safe to bees and the area treated has an overwhelming influence on predicting whether incidents with any particular insecticide are reported.

Hazard ratios (HR) were generated for the active ingredients used on crops in Canada by taking the maximum application rate and dividing it by the bee contact toxicity value. To set an appropriate standard, the HR cut-off value proposed by the European Commission (2002) of 50

was chosen. All HR values reported above 50 do not meet the bee toxicity standard. To further designate extreme risk, all compounds with an HR value exceeding 400 were flagged as red compounds. The standard may be considered by many to be too protective in that, if adopted, it would essentially prevent all possibility of mass mortality of native pollinators. However, as reviewed in Harding *et al.* (2006), pollination is currently in crisis and this carries a real economic and social cost.

The terrestrial invertebrate standard based on honeybee toxicity will be that applications to areas frequented by natural pollinators should not exceed a hazard ratio of 50 corresponding to a calculated risk score of 0.33. This risk score is computed by comparing the logHR value of the application to a theoretical upper bound of a logHR of 5.

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
DUB	Chlorpyrifos	Insecticide	0.06	3.0	4995	83250	4.92	0.98
PFL	Permethrin	Insecticide	0.06	8.0	2500	41667	4.62	0.92
DIA	Diazinon	Insecticide	0.32	4.0	11600	36250	4.56	0.91
CYM	Cypermethrin	Insecticide	0.03	5.0	949.67	31656	4.50	0.90
PYD	Pyridaben	Insecticide	0.02	3.0	540	27000	4.43	0.89
DIM	Dimethoate	Insecticide	0.16	3.0	2400	15000	4.18	0.84
IMI	Imidacloprid	Insecticide	0.03	3.0	312	10400	4.02	0.80
MAL	Malathion	Insecticide	0.53	3.0	3750	7075	3.85	0.77
CAF	Carbofuran	Insecticide	0.18	2.0	1200	6667	3.82	0.76
COD	Clothianidin	Insecticide	0.01271	34.6	83.35	6558	3.82	0.76
ZIN	Zineb	Fungicide	0.50	5.0	2640	5280	3.72	0.74
GOO	Azinphos-methyl	Insecticide	0.48	2.0	2220	4625	3.67	0.73
NAL	Naled	Insecticide	0.53	5.0	1900.8	3586	3.55	0.71

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
MML	Methomyl	Insecticide	0.67	0.5	1935	2888	3.46	0.69
CAB	Carbaryl	Insecticide	3.91	7.0	9804	2507	3.40	0.68
DBR	Deltamethrin	Insecticide	0.01	3.0	20	2000	3.30	0.66
ACP	Acephate	Insecticide	1.35	2.5	2550	1889	3.28	0.66
MOM	Methamidophos	Insecticide	0.59	4.0	1104	1871	3.27	0.65
PRT	Phosmet	Insecticide	1.66	3.0	1875	1130	3.05	0.61
OXB	Oxamyl	Insecticide	2.04	4.0	2244	1100	3.04	0.61
DCB	Dichlobenil	Herbicide	11.00	5.0	9000	818	2.91	0.58
EPT	EPTC	Herbicide	12.09	3.0	6800	562	2.75	0.55
ESF	Endosulfan	Insecticide	8.39	3.0	4500	536	2.73	0.55
FER	Ferbam	Fungicide	12.10	3.0	6270	518	2.71	0.54
THI	Thiram	Fungicide	73.85	8.0	30000	406	2.61	0.52
AMI	Amitrole	Herbicide	34.64	5.0	10630	307	2.49	0.50
BET	Bensulide	Herbicide	24.00	30.0	6720	280	2.45	0.49
MAN	Maneb	Fungicide	12.00	3.0	2600	217	2.34	0.47
CYH	Cyhalothrin-lambda	Insecticide	0.11	5.0	22.936	209	2.32	0.46
DIK	Dichloran	Fungicide	181.00	4.0	33000	182	2.26	0.45
PYR	Pyrethrins	Insecticide	0.07	10.0	10	143	2.15	0.43
CAP	Captan	Fungicide	92.51	2.0	12500	135	2.13	0.43
MCZ	Mancozeb	Fungicide	53.50	10.0	7200	135	2.13	0.43
FOL	Folpet	Fungicide	49.19	3.4	5000	102	2.01	0.40
ZIR	Ziram	Fungicide	68.26	5.0	6800	100	2.00	0.40
ETF	Ethephon	Growth Regulator	34.79	5.0	3360	97	1.98	0.40
MAB	MCPA (dimethylamine salt)	Herbicide	25.00	7.0	2375	95	1.98	0.40

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
PEN	Pendimethalin	Herbicide	11.81	30.0	1088	92	1.96	0.39
TRL	Triallate	Herbicide	25.00	15.0	2208	88	1.95	0.39
MAE	MCPA (unspecified ester)	Herbicide	25.00	8.0	1750	70	1.85	0.37
MBS	MCPB (sodium salt)	Herbicide	25.00	7.0	1700	68	1.83	0.37
DXA	2,4-D (acid)	Herbicide	42.58	5.0	2726	64	1.81	0.36
NAP	Naptalam (form not specified)	Herbicide	113.20	7.0	7200	64	1.80	0.36
ETS	Ethofumesate	Herbicide	63.00	10.0	3960	63	1.80	0.36
PAQ	Paraquat (form not specified)	Herbicide	25.54	30.0	1500	59	1.77	0.35
MTR	Metiram	Fungicide	83.62	7.0	4800	57	1.76	0.35
MAH	Maleic hydrazide (form not specified)	Growth Regulator	60.25	10.0	3390	56	1.75	0.35
NBP	Napropamide	Herbicide	121	15.0	6700	55	1.74	0.35
SMZ	Simazine	Herbicide	97.84	5.0	5400	55	1.74	0.35
TRI	Trichlorfon	Insecticide	59.80	3.0	3200	54	1.73	0.35
DOD	Dodine (dodecylguanidine monoacetate)	Fungicide	41.37	10.0	2112.5	51	1.71	0.34
DCF	Dicofol	Insecticide	50.00	4.0	2550	51	1.71	0.34
SOD	Sethoxydim	Herbicide	10.00	3.0	495	50	1.69	0.34
MMM	Thifensulfuron-methyl	Herbicide	25.00	3.0	1237.5	50	1.69	0.34
GPS	Glyphosate (acid)	Herbicide	100.00	3.0	4950	50	1.69	0.34
PHS	Phosalone	Insecticide	13.37	8.0	625	47	1.67	0.33
MFN	Metalaxyl-m (mefenoxam)	Fungicide	25.00	3.7	1111	44	1.65	0.33

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
GPI	Glyphosate (isopropylamine salt)	Herbicide	100.00	2.5	4320	43	1.64	0.33
TRF	Trifluralin	Herbicide	49.16	3.0	2016	41	1.61	0.32
ATR	Atrazine	Herbicide	98.49	5.0	4000	41	1.61	0.32
TPR	Triclopyr	Herbicide	100.00	9.2	3840	38	1.58	0.32
DIC	Dicamba (form not specified)	Herbicide	90.65	9.0	3429.3	38	1.58	0.32
BAX	Metribuzin	Herbicide	60.40	5.0	2250	37	1.57	0.31
DUR	Diuron	Herbicide	145.03	30.0	5400	37	1.57	0.31
PIC	Picloram (form not specified)	Herbicide	61.71	8.0	2160	35	1.54	0.31
MAA	MCPA (acid)	Herbicide	50.00	8.0	1750	35	1.54	0.31
MEC	Mecoprop (form not specified)	Herbicide	25.00	10.0	850	34	1.53	0.31
TET	Chlorothalonil	Fungicide	181.29	5.0	5800	32	1.51	0.30
DXF	2,4-D (unspecified ester)	Herbicide	100.00	5.0	3135	31	1.50	0.30
FAL	Fosetyl-al	Fungicide	143.74	0.1	4480	31	1.49	0.30
PRO	Prometryne	Herbicide	112.11	10.0	3400	30	1.48	0.30
DYR	Anilazine	Fungicide	117.23	1.0	3375	29	1.46	0.29
EFR	Ethalfluralin	Herbicide	51.00	4.0	1400	27	1.44	0.29
PIR	Pirimicarb	Insecticide	32.07	7.0	850	27	1.42	0.28
BRY	Bromoxynil (octanoate)	Herbicide	14.14	3.0	337.5	24	1.38	0.28
AMZ	Amitraz	Insecticide	70.71	1.0	1675	24	1.37	0.27
AVG	Difenzoquat (methyl sulphate salt)	Herbicide	36.00	30.0	850	24	1.37	0.27
PYZ	Pyrazon (chloridazon)	Herbicide	193.00	5.0	4407.5	23	1.36	0.27

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
CUZ	Copper (copper hydroxide)	Fungicide	100.00	68.9	2250	23	1.35	0.27
DIH	Dichlorprop (unspecified ester)	Herbicide	25.00	9.0	525	21	1.32	0.26
NXI	Acetamiprid	Insecticide	8.10	4.9	168	21	1.32	0.26
VPR	Hexazinone	Herbicide	100.00	30.0	2025	20	1.31	0.26
MTL	Metolachlor	Herbicide	110.00	5.0	2148	20	1.29	0.26
TER	Terbacil	Herbicide	193.00	30.0	3600	19	1.27	0.25
GPT	Glyphosate (trimethylsulfonium salt)	Herbicide	213.21		3970	19	1.27	0.25
PHY	Propamocarb hydrochloride	Fungicide	54.51	15.0	1012.5	19	1.27	0.25
DIQ	Diquat (form not specified)	Herbicide	64.14	30.0	1104	17	1.24	0.25
DPB	2,4-DB (form not specified)	Herbicide	100.00	5.0	1718.75	17	1.24	0.25
SUL	Sulphur	Fungicide	1051.00	23.1	18000	17	1.23	0.25
QTZ	Quintozene	Fungicide	100.00	4.0	1687.5	17	1.23	0.25
FMS	Foramsulfuron	Herbicide	1.90	8.1	30	16	1.20	0.24
TPM	Thiophanate-methyl	Fungicide	100.00	5.0	1575	16	1.20	0.24
CFZ	Clofentezine	Insecticide	20	5.0	300	15	1.18	0.24
KRB	Propyzamide	Herbicide	181.00	20.0	2250	12	1.09	0.22
AME	S-Metolachlor	Herbicide	130.38	7.0	1601.25	12	1.09	0.22
TEU	Tebuconazole	Fungicide	10.28	12.3	126.144	12	1.09	0.22
FLT	Flufenacet	Herbicide	69.64	8.0	799.68	11	1.06	0.21
BTL	Desmedipham	Herbicide	63.83	5.0	712.5	11	1.05	0.21
CNQ	Clomazone	Herbicide	100.00	3.0	1116	11	1.05	0.21
LUN	Linuron	Herbicide	439.75	15.0	4500	10	1.01	0.20
KRS	Kresoxim-methyl	Fungicide	22.36	4.1	225	10	1.00	0.20

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
VIL	Vinclozolin	Fungicide	100.00	3.0	1000	10	1.00	0.20
CYO	Cymoxanil	Fungicide	25.00	3.6	210	8	0.92	0.18
MOR	Chinomethionat	Fungicide	66.47	10.0	500	8	0.88	0.18
PMP	Phenmedipham	Herbicide	109.94	5.0	712.5	6	0.81	0.16
DME	Dimethomorph	Fungicide	36.84	7.1	225	6	0.79	0.16
TRR	Triforine	Fungicide	100.00	5.0	585	6	0.77	0.15
MEI	Dimethenamid	Herbicide	306.59	5.3	1683	5	0.74	0.15
GLG	Glufosinate ammonium	Herbicide	185.88	4.0	1000.5	5	0.73	0.15
FEX	Fenhexamid	Fungicide	158.74	1.8	850	5	0.73	0.15
IPD	Iprodione	Fungicide	282.84	5.0	1500	5	0.72	0.14
ASS	Imazamethabenz (form not specified)	Herbicide	100.00	18.0	499.82	5	0.70	0.14
OXR	Oxyfluorfen	Herbicide	100.00	8.0	496	5	0.70	0.14
FAD	Famoxadone	Fungicide	50.00	5.8	210	4	0.62	0.12
PON	Propiconazole	Fungicide	50.00	30.0	190	4	0.58	0.12
MEM	Metsulfuron-methyl	Herbicide	25.00	30.0	90	4	0.56	0.11
BAD	6-Benzyladenine	Growth Regulator	25.00	11.7	76.32	3	0.48	0.10
IMP	Imazethapyr	Herbicide	316.23	30.0	951.521	3	0.48	0.10
FLZ	Fluazinam	Fungicide	54.29	6.7	160	3	0.47	0.09
FLR	Fluroxypyr 1-methylheptyl ester	Herbicide	50.00	5.5	144	3	0.46	0.09
FOF	Fomesafen	Herbicide	100.00	8.6	240	2	0.38	0.08
MXF	Methoxyfenozide	Insecticide	100.00	17.0	240	2	0.38	0.08
PYA	Pyraclostrobin	Fungicide	100.00	7.5	225	2	0.35	0.07
ZOX	Zoxamide	Fungicide	100.00	4.5	224	2	0.35	0.07
FZA	Fluazifop-p-butyl	Herbicide	112.25	4.0	250	2	0.35	0.07

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
CYP	Cyprodinil	Fungicide	274.27	5.8	562.5	2	0.31	0.06
DAZ	Dazomet	Multipurpose	24.00	3.7	49	2	0.31	0.06
DPI	Clopyralid	Herbicide	100.00	2.0	200.25	2	0.30	0.06
TRA	Tralkoxydim	Herbicide	100.00	3.4	200	2	0.30	0.06
MEX	Tribenuron methyl	Herbicide	100.00	4.0	187.5	2	0.27	0.05
ETM	Ethametsulfuron (form not specified)	Herbicide	12.50	15.5	22.5	2	0.26	0.05
CYZ	Cyromazine	Insecticide	158.11	30.0	279.75	2	0.25	0.05
TFS	Triflusulfuron methyl	Herbicide	20.00	3.0	35	2	0.24	0.05
MER	Mesotrione	Herbicide	100.00	5.9	144	1	0.16	0.03
AZY	Azoxystrobin	Fungicide	200.00	3.0	281.25	1	0.15	0.03
CLM	Cloransulam (form not specified)	Herbicide	25.00	6.7	35.028	1	0.15	0.03
FED	Fenamidone	Fungicide	74.80	11.3	100	1	0.13	0.03
TFZ	Tebufenozide	Insecticide	234.00	3.0	288	1	0.09	0.02
IXF	Isoxaflutole	Herbicide	100.00	3.0	105.6	1	0.02	0.00
IMZ	Imazamox	Herbicide	32.65	3.0	25.2	1	-0.11	0.00
SLF	Sulfosulfuron	Herbicide	27.39	11.9	20.25	1	-0.13	0.00
CLE	Clethodim	Herbicide	125.99	7.0	91.2	1	-0.14	0.00
CHE	Chlorimuron-ethyl	Herbicide	12.50	15.0	9	1	-0.14	0.00
FLM	Flumetsulam	Herbicide	100.00	15.7	70.668	1	-0.15	0.00
CFP	Clodinafop-propargyl	Herbicide	100.00	1.7	69.6	1	-0.16	0.00
NIO	Nicosulfuron	Herbicide	38.99	5.0	25.05	1	-0.19	0.00
DFF	Diflufenzopyr (form not specified)	Herbicide	90.00		57	1	-0.20	0.00

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
TFY	Trifloxystrobin	Fungicide	200.00	10.9	122.5	1	-0.21	0.00
QUC	Quinclorac	Herbicide	248.68	3.0	123.75	0	-0.30	0.00
PZN	Pymetrozine	Insecticide	200.00	9.2	96.5	0	-0.32	0.00
CSL	Chlorsulfuron	Herbicide	25.00	30.0	11.25	0	-0.35	0.00
VIT	Carbathiin	Fungicide	181.00	3.8	76.05	0	-0.38	0.00
MYC	Myclobutanil	Fungicide	362.00	15.9	136	0	-0.43	0.00
FPF	Fenoxaprop-p-ethyl	Herbicide	300.00	5.6	100.625	0	-0.47	0.00
PRI	Primisulfuron-methyl	Herbicide	100.00	7.0	30	0	-0.52	0.00
FOM	Formetanate (form not specified)	Insecticide	14000.00	30.0	4121.6	0	-0.53	0.00
BMS	Flusilazole	Fungicide	150.00	14.8	40	0	-0.57	0.00
DFZ	Difenoconazole	Fungicide	100.33	10.9	26.286	0	-0.58	0.00
PFN	Picolinafen	Herbicide	200.00	9.1	50.25	0	-0.60	0.00
TPA	Tepraloxydim	Herbicide	200.00	10.9	50	0	-0.60	0.00
TRS	Triasulfuron	Herbicide	100.00	9.5	24.75	0	-0.61	0.00
PID	Picloram (triisopropanolamine salt)	Herbicide	100.00	8.0	24	0	-0.62	0.00
MPR	(S)-Methoprene	Insecticide	1000.00	3.4	238	0	-0.62	0.00
DPY	Rimsulfuron	Herbicide	100.00	3.0	15	0	-0.82	0.00
FLS	Flucarbazone-sodium	Herbicide	200.00	8.0	28.38	0	-0.85	0.00
TRT	Triticonazole	Fungicide	48.99	12.7	6	0	-0.91	0.00
PSF	Prosulfuron	Herbicide	100.00	3.0	9.975	0	-1.00	0.00
FRA	Florasulam	Herbicide	100.00	4.0	5	0	-1.30	0.00
FLD	Fludioxonil	Fungicide	50.25	14.9	1.898	0	-1.42	0.00
HEC	Hexaconazole	Fungicide	100.00	14.3	1.892	0	-1.72	0.00

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
IDO	Iodosulfuron-methyl-sodium	Herbicide	150.00	4.6	2	0	-1.88	0.00
DIN	Dinocap	Fungicide	29000.00	8.0	317.25	0	-1.96	0.00
TZL	Thiabendazole	Fungicide	na	30.0	1000			
ENT	Endothall (form not specified)	Herbicide	na	7.0	1364			
ACA	Acifluorfen (form not specified)	Herbicide	na	5.0	600			
DPP	Diclofop-methyl	Herbicide	na	8.0	994			
BZN	Bentazon (form not specified)	Herbicide	na	2.0	1080			
CHH	Boscalid	Fungicide	na	16.5	539			
FBZ	Indar	Fungicide	na	18.6	105			
SPI	Spinosad	Insecticide	0.00	4.9	105.6			
AMN	Aminoethoxyvinylglycine	Growth Regulator	na		125			
CCC	Chlormequat (form not specified)	Growth Regulator	na	6.4	1380			
CHL	Chlorthal (form not specified)	Herbicide	na	10.0	13500			
CUS	Copper (copper sulphate)	Algicide, Fungicide	na	7.0	8.25			
CUY	Copper (copper oxychloride)	Fungicide	na		4500			
DPA	Diphenylamine	Fungicide	na	1.3	2048			
DXB	2,4-D (unspecified amine salt)	Herbicide	na	9.0	2760			
FAA	N-Decanol	Growth Regulator	na	2.1	14440			
FAB	N-Octanol	Herbicide	na	1.1	16082			
FOR	Formaldehyde	Fungicide	na	2.2	1187.7			

Table 16: Bee hazard ratios for pesticides used on crops in Canada listed with their associated bee contact LD50 value and maximum application rate (g ai/ha).

AI Code	AI Accepted Name	Type	BEE Contact LD50 (ug/bee)	Foliar DT50 FINAL	application rate (g ai/ha)	HR	Log HR	Risk Score
GPM	Glyphosate (mono-ammonium salt)	Herbicide	na		4350			
GPP	Glyphosate (potassium salt)	Herbicide	na		4320			
MAS	MCPA (potassium salt)	Herbicide	na		2700			
MEA	Mecoprop (potassium salt)	Herbicide	na		1155			
MEW	Mecoprop d-isomer (potassium salt)	Herbicide	na		1050			
MEZ	Mecoprop d-isomer (amine salt)	Herbicide	na	2.7	850			
NAA	1-Naphthalene actetic acid (form not specified)	Growth Regulator	na	5.0	0.001136			
NAD	Naphthaleneacetamide	Growth Regulator	na	5.0	166.8			
QPE	Quizalofop p-ethyl	Herbicide	na	6.3	72			
TCM	2-(Thiocyanomethylthio)benzothiazole	Fungicide	na	2.0	73.6			

13 PREDICTED EARTHWORM MORTALITY WITH ASSOCIATED LC50 VALUES AND PMRA RISK QUOTIENTS (RQ'S).

The table below shows the predicted earthworm losses following the application of compounds registered in Canada at the highest permitted rate.

Long-term effect of pesticides on earthworms depends on the acute effect, the reproductive

toxicity and the persistence of the substance. This makes it difficult to make an accurate prediction of earthworm recovery after pesticide exposure. However, population modeling can give some insight into this problem.

We propose that a predicted loss of earthworm above 65 % after a single pesticide application should be considered severe (red coding) and requires mitigating measures; predicted earthworm losses of less than 35% after a single application are deemed to pose a low risk to the ecosystem (green coding).

The current assessment of earthworm impacts by the PMRA assumes equal mixing of the pesticide in the top 15 cm of soil. This leads to a clear underestimate of the real impact of pesticide applications. Also, data are lacking for many compounds, including some products know to be very toxic to earthworms; e.g., the carbamate insecticide carbofuran.

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
TEL	Tefluthrin	7350	2	0.93	1.63
ESF	Endosulfan	4500	9.732418	0.73	0.21
DIA	Diazinon	11600	79.95159	0.54	0.06
AMZ	Amitraz	1675	20	0.54	0.04
DCF	Dicofol	2550	32.78719	0.51	0.03
ATR	Atrazine	4000	47.29523	0.51	0.04
KRB	Propyzamide	2250	32.78719	0.50	0.03
IMI	Imidacloprid	312	11	0.45	0.01
MOM	Methamidophos	1104	33.00504	0.43	0.01
GOO	Azinphos-methyl	2220	59	0.42	0.02
NXI	Acetamiprid	168	9	0.41	0.01
TPR	Triclopyr	3840	100	0.40	0.02

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
ZIR	Ziram	6800	163.0951	0.39	0.02
THI	Thiram	30000	540	0.37	0.02
ETS	Ethofumesate	3960	130.9302	0.36	0.01
MML	Methomyl	1935	86.88198	0.35	0.01
AMI	Amitrole	10630	307.4541	0.35	0.02
PYD	Pyridaben	540	38	0.34	0.01
OXB	Oxamyl	2244	112	0.33	0.01
PRO	Prometryne	3400	153	0.33	0.01
PHS	Phosalone	625	45	0.33	0.01
EPT	EPTC	6800	267	0.32	0.01
PIR	Pirimicarb	850	60	0.32	0.01
DIK	Dichloran	33000	885	0.32	0.02
PYA	Pyraclostrobin	225	23.74868	0.31	0.00
CAP	Captan	12500	449.2209	0.31	0.01
TET	Chlorothalonil	5800	268	0.31	0.01
MTL	Metolachlor	2148	140	0.30	0.01
COD	Clothianidin	83.35	14.42221	0.28	0.00
TRL	Triallate	2208	162	0.28	0.01
DUB	Chlorpyrifos	4995	353.322	0.26	0.01
FOL	Folpet	5000	394.4629	0.25	0.01
PMP	Phenmedipham	712.5	104.2543	0.23	0.00
FED	Fenamidone	100	25	0.23	0.00
DIQ	Diquat (form not specified)	1104	152.0054	0.23	0.00
MTR	Metiram	4800	464.1589	0.22	0.00
BRY	Bromoxynil (octanoate)	337.5	69.7079	0.22	0.00
MAA	MCPA (acid)	1750	245.4511	0.21	0.00
FER	Ferbam	6270	625	0.21	0.00

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
GPS	Glyphosate (acid)	4950	582.5901	0.20	0.00
BAX	Metribuzin	2250	332	0.20	0.00
DCB	Dichlobenil	9000	1000	0.19	0.00
DXB	2,4-D (unspecified amine salt)	2760	472.293	0.18	0.00
DUR	Diuron	5400	798	0.17	0.00
CNQ	Clomazone	1116	260.9835	0.17	0.00
SUL	Sulphur	18000	2000	0.17	0.00
MEI	Dimethenamid	1683	367.7499	0.16	0.00
CCC	Chlormequat (form not specified)	1380	320	0.16	0.00
FLT	Flufenacet	799.68	221.3089	0.16	0.00
TRA	Tralkoxydim	200	86.7663	0.15	0.00
SMZ	Simazine	5400	1000	0.15	0.00
CYP	Cyprodinil	562.5	209.4682	0.14	0.00
LUN	Linuron	4500	1000	0.14	0.00
FAL	Fosetyl-al	4480	1000	0.14	0.00
PYZ	Pyrazon (chloridazon)	4407.5	1050	0.13	0.00
CYZ	Cyromazine	279.75	141.4214	0.13	0.00
GPT	Glyphosate (trimethylsulfonium salt)	3970	1000	0.13	0.00
FOM	Formetanate (form not specified)	4121.6	1048	0.13	0.00
AME	S-Metolachlor	1601.25	570	0.12	0.00
MAH	Maleic hydrazide (form not specified)	3390	1000	0.12	0.00
PAQ	Paraquat (form not specified)	1500	617.054	0.11	0.00
BTL	Desmedipham	712.5	466.4997	0.09	0.00
TRF	Trifluralin	2016	1000	0.08	0.00
CUZ	Copper (copper hydroxide)	2250	1088	0.08	0.00

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
DPB	2,4-DB (form not specified)	1718.75	1000	0.08	0.00
TZL	Thiabendazole	1000	707.1068	0.07	0.00
AZY	Azoxystrobin	281.25	281.3234	0.07	0.00
IPD	Iprodione	1500	1000	0.07	0.00
MFN	Metalaxyl-m (mefenoxam)	1111	830	0.07	0.00
BZN	Bentazon (form not specified)	1080	870	0.06	0.00
PEN	Pendimethalin	1088	1000	0.05	0.00
PHY	Propamocarb hydrochloride	1012.5	1000	0.05	0.00
GLG	Glufosinate ammonium	1000.5	1000	0.05	0.00
DPP	Diclofop-methyl	994	1000	0.05	0.00
MYC	Myclobutanil	136	250	0.05	0.00
FEX	Fenhexamid	850	1000	0.04	0.00
CYH	Cyhalothrin-lambda	22.936	76.23422	0.04	0.00
ACP	Acephate	2550	2670.147	0.03	0.00
PON	Propiconazole	190	414.1256	0.03	0.00
FAD	Famoxadone	210	470	0.03	0.00
CFP	Clodinafop-propargyl	69.6	210	0.03	0.00
TRR	Triforine	585	1000	0.03	0.00
MOR	Chinomethionat	500	1000	0.02	0.00
GPI	Glyphosate (isopropylamine salt)	4320	5000	0.02	0.00
TFZ	Tebufenozide	288	1000	0.01	0.00
ZOX	Zoxamide	224	849.2596	0.01	0.00
KRS	Kresoxim-methyl	225	869.9884	0.01	0.00
CLE	Clethodim	91.2	454	0.01	0.00
FZA	Fluazifop-p-butyl	250	1000	0.01	0.00
FOF	Fomesafen	240	1000	0.01	0.00
DME	Dimethomorph	225	1000	0.01	0.00

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
DPI	Clopyralid	200.25	1000	0.00	0.00
MXF	Methoxyfenozide	240	1213	0.00	0.00
BMS	Flusilazole	40	388	0.00	0.00
FLZ	Fluazinam	160	1112.26	0.00	0.00
MEX	Tribenuron methyl	187.5	1263.515	0.00	0.00
TEU	Tebuconazole	126.144	1007.358	0.00	0.00
TFY	Trifloxystrobin	122.5	1000	0.00	0.00
SPI	Spinosad	105.6	961.3667	0.00	0.00
IXF	Isoxaflutole	105.6	1000	0.00	0.00
FPF	Fenoxaprop-p-ethyl	100.625	1000	0.00	0.00
CYO	Cymoxanil	210	2153.323	0.00	0.00
MEM	Metsulfuron-methyl	90	1000	0.00	0.00
PZN	Pymetrozine	96.5	1098	0.00	0.00
MER	Mesotrione	144	2000	0.00	0.00
PFN	Picolinafen	50.25	1000	0.00	0.00
TPA	Tepraloxydim	50	1000	0.00	0.00
TLL	Triadimenol	38.04	772	0.00	0.00
MTA	Metalaxyl	47.93	1000	0.00	0.00
DFZ	Difenoconazole	26.286	610	0.00	0.00
TFS	Triflusulfuron methyl	35	1000	0.00	0.00
QUC	Quinclorac	123.75	4000	0.00	0.00
FMS	Foramsulfuron	30	1000	0.00	0.00
PRI	Primisulfuron-methyl	30	1000	0.00	0.00
THE	Thiamethoxam	28.56	1000	0.00	0.00
FLS	Flucarbazone-sodium	28.38	1000	0.00	0.00
IMZ	Imazamox	25.2	901	0.00	0.00
NIO	Nicosulfuron	25.05	1000	0.00	0.00

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
TRS	Triasulfuron	24.75	1000	0.00	0.00
SLF	Sulfosulfuron	20.25	848	0.00	0.00
ETM	Ethametsulfuron (form not specified)	22.5	1000	0.00	0.00
DBR	Deltamethrin	20	1290	0.00	0.00
DPY	Rimsulfuron	15	1000	0.00	0.00
PSF	Prosulfuron	9.975	1000	0.00	0.00
TRT	Triticonazole	6	1000	0.00	0.00
CSL	Chlorsulfuron	11.25	2000	0.00	0.00
HEC	Hexaconazole	1.8918	414	0.00	0.00
FRA	Florasulam	5	1320	0.00	0.00
CHE	Chlorimuron-ethyl	9	4050	0.00	0.00
IDO	Iodosulfuron-methyl-sodium	2	1000	0.00	0.00
FLD	Fludioxonil	1.898	1000	0.00	0.00
FAB	N-Octanol	16082			
FAA	N-Decanol	14440			
CHL	Chlorthal present as acid or as dimethyl ester	13500			
CAB	Carbaryl	9804			
MCZ	Mancozeb	7200			
NAP	Naptalam present as acid or as sodium salt	7200			
BET	Bensulide	6720			
NBP	Napropamide	6700			
CUY	Copper as elemental, present as copper oxychloride	4500			
GPM	Glyphosate (present as mono-ammonium salt)	4350			
GPP	Glyphosate (present as potassium salt)	4320			
PHR	Phorate	4305			

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
MAL	Malathion	3750			
TER	Terbacil	3600			
DIC	Dicamba present as acid, as diethanolamine salt, as dimethylamine salt, or as butoxyethyl ester, or as sodium salt	3429.3			
DYR	Anilazine	3375			
ETF	Ethephon	3360			
TRI	Trichlorfon	3200			
DXF	2,4-D present as low volatile esters	3135			
DXA	2,4-D present as acid	2726			
MAS	MCPA present as potassium salt or as sodium salt	2700			
MET	Methoxychlor	2700			
ZIN	Zineb	2640			
MAN	Maneb	2600			
PFL	Permethrin	2500			
DIM	Dimethoate	2400			
MAB	MCPA present as amine salts (diethanolamine, dimethylamine, or mixed amines)	2375			
PIC	Picloram present as acid or as isooctyl esters or as potassium salt	2160			
DOD	Dodine	2112.5			
DPA	Diphenylamine	2048			
VPR	Hexazinone	2025			
NAL	Naled	1900.8			
PRT	Phosmet	1875			

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
MAE	MCPA present as esters	1750			
MBS	MCPB present as sodium salt	1700			
QTZ	Quintozene	1687.5			
TPM	Thiophanate-methyl	1575			
EFR	Ethalfluralin	1400			
ENT	Endothall present as dipotassium salt	1364			
COY	Terbufos	1350			
MMM	Thifensulfuron methyl	1237.5			
CAF	Carbofuran	1200			
FOR	Formaldehyde	1187.7			
MEA	Mecoprop present as potassium salt	1155			
MEW	Mecoprop d-isomer present as potassium salt	1050			
VIL	Vinclozolin	1000			
IMP	Imazethapyr	951.521			
CYM	Cypermethrin	949.67			
AVG	Difenzoquat present as methyl sulphate salt	850			
MEC	Mecoprop present as amine salts	850			
MEZ	Mecoprop d-isomer present as amine salt	850			
ACA	Acifluorfen	600			
CHH	BAS 510 F	539			
DIH	Dichlorprop (present as butoxyethyl ester, as isooctyl ester, or as ethylhexyl ester)	525			
ASS	Imazamethabenz	499.82			
OXR	Oxyfluorfen	496			
SOD	Sethoxydim	495			

Table 17: Predicted earthworm mortality with associated LC50 values and PMRA risk quotients (RQ's).

AI Code	AI Accepted Name	Maximum Application Rate (g ai/ha)	LC50 (ug/g)	Mortality based on regression model (LC50, application rate)	PMRA RQ (LC50)
DIN	Dinocap plus related active compounds	317.25			
CFZ	Clofentezine	300			
MPR	(S)-Methoprene	238			
FLR	Fluroxypyr 1-methylheptyl ester	144			
AMN	Aminoethoxyvinylglycine	125			
FBZ	Indar	105			
BAD	6-Benzylaminopurine (Or: 6-Benzyladenine)	76.32			
VIT	Carbathiin	76.05			
TCM	2-(Thiocyanomethylthio)benzothiazole	73.6			
QPE	Quizalofop p-ethyl	72			
FLM	Flumetsulam	70.668			
DFF	Diflufenzopyr	57			
DAZ	Dazomet	49			
CLM	N-(2-Carboxymethyl-6-chlorophenyl)-5-ethoxy-7-fluro[1,2,4]triazolo-[1,5c]-pyrimidine-2-Sulfonamide	35.028			
PID	Picloram present as amine salts (alkanolamine salt, diethanolamine salt, or triisopropanolamine salt)	24			
PYR	Pyrethrins	10			
CUS	Copper as elemental, present as copper sulphate	8.25			
NAA	Naphthalene acetic acid (present as ethyl ester, sodium salt, or as ammonium salt)	0.001136			

14 RESULTS FROM ALL THREE EMPIRICALLY DERIVED AQUATIC MODELS: CRUSTACEA COUNT RATIO, THE MOST CONSERVATIVE ABUNDANCE MODEL (CLADOCERA OR COPEPODA), AND THE ALGAL MODEL. HC5 VALUES ARE ALSO GIVEN AS WELL AS THE ESTIMATED WATER CONCENTRATIONS FOR BOTH PUDDLE AND POND SCENARIOS.

Estimated water concentrations (based on the conversion from GENEEC (GENeric Estimated Environmental Concentration model) estimates to the 95% upper tail of Pesticide Root Zone Model (PRZM) runs for Manitoba) were calculated for all compounds for both a puddle and pond scenario (see Mineau *et al.*, 2008). For the development of proposed standards, only the results derived from the pond scenario were used, as they are believed to be more realistic – or at least reflect aquatic systems we should attempt to protect. Combining these estimated concentrations with the appropriate toxicity values (see Mineau *et al.*, 2008; section 7.3), the number of expected toxicity units was calculated for all pesticides. Finally, these TU values were entered into the crustacean, cladocera, copepod or algae models and effect levels – either count ratios of affected species or abundances – were computed (shown in table below).

We propose to set the level of acceptability at a 20% loss – whether total biomass or the proportion of significantly affected species. We believe that applications with impact levels exceeding 50% should be 'red-listed' and slated for immediate replacement and/or mitigation. Disturbances affecting 50% of species or more than 50% of total biomass are likely to be of long duration and/or have ripple effects on the rest of the aquatic community.

With three invertebrate indicators (Crustacea species counts, Copepoda, and Cladocera abundance), a method was needed to combine the results into a single aquatic invertebrate index. The more conservative of the two abundance ratios was retained. However, in order to be 'red-

listed' both abundance and count ratio variables have to exceed 50%. Conversely, to meet our proposed standard, both abundance and count ratio effects must be maintained below 20%.

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
PHR	Phorate	I	8.01976	2.52049	0.006552	89.36402	0.88	0.98	0.00
TEL	Tefluthrin	I	0.97207	0.30551	0.000961		0.87	0.98	
DIM	Dimethoate	I	5.94989	1.86996	0.01	3348.599	0.83	0.98	0.00
MOM	Methamidophos	I	2.40764	0.75669	0.019595	12236	0.73	0.95	0.00
DIA	Diazinon	I	17.36123	5.45638	0.191321	687.4155	0.71	0.95	0.00
CYH	Cyhalothrin-lambda	I	0.00086	0.00027	0.000593	30.80587	0.71	0.73	0.00
TRI	Trichlorfon	I	8.84743	2.78062	0.128814	1805.516	0.70	0.94	0.00
DUB	Chlorpyrifos	I	1.66578	0.52353	0.05	93.88774	0.65	0.92	0.00
THI	Thiram	F	11.09192	3.48603	0.438695	33.81712	0.63	0.91	0.00
PFL	Permethrin	I	0.30529	0.09595	0.01412	5.942676	0.62	0.91	0.00
CAF	Carbofuran	I	3.39825	1.06802	0.17958	18741.7	0.62	0.90	0.00
GOO	Azinphos-methyl	I	2.37405	0.74613	0.14		0.61	0.90	
CYM	Cypermethrin	I	0.10139	0.03187	0.006662	687.4155	0.60	0.90	0.00
CAB	Carbaryl	I	24.18839	7.60205	1.927547	573.8559	0.59	0.89	0.00
FER	Ferbam	F	13.56542	4.26341	1.379766	164.9797	0.57	0.88	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
TET	Chlorothalonil	F	13.34131	4.19298	1.385601	3.784942	0.57	0.87	0.00
NAL	Naled	I	1.40485	0.44152	0.154248	2.678181	0.57	0.87	0.00
ESF	Endosulfan	I	0.99554	0.31289	0.136505	38.49527	0.56	0.86	0.00
COY	Terbufos	I	0.77438	0.24337	0.18		0.52	0.83	
PYD	Pyridaben	I	0.03892	0.01223	0.010213	56.05704	0.52	0.82	0.00
PRT	Phosmet	I	2.14120	0.67295	0.792562	4.811909	0.49	0.79	0.00
ZIR	Ziram	F	13.91432	4.37307	5.737181	31.52815	0.49	0.78	0.00
DIN	Dinocap	I	0.31275	0.09829	0.161384	2165.359	0.47	0.76	0.00
MCZ	Mancozeb	I	4.56922	1.43604	3.62481	1.391292	0.45	0.72	0.00
OXB	Oxamyl	I	6.30691	1.98217	6.186997	226.8471	0.43	0.70	0.00
PHS	Phosalone	I	0.32126	0.10097	0.340728		0.43	0.69	
IMI	Imidacloprid	F	0.46035	0.14468	0.703904	687.4155	0.40	0.66	0.00
FOL	Folpet	I	12.46364	3.91714	20.30661	28.33976	0.40	0.65	0.00
DBR	Deltamethrin	I	0.00079	0.00025	0.001467	6557.526	0.39	0.64	0.00
FOM	Formetanate (form not specified)	I	9.02920	2.83774	18.10247	103.1123	0.39	0.63	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
MAL	Malathion	I	0.19508	0.06131	0.416534		0.38	0.62	
DIK	Dichloran	F	51.07456	16.05198	122.8907		0.38	0.61	
MET	Methoxychlor	I	0.25909	0.08143	0.647669		0.37	0.61	
MML	Methomyl	I	5.54116	1.74151	14.34749	4124.493	0.37	0.60	0.00
MOR	Chinomethionat	I	0.19324	0.06073	0.503819	2.421692	0.37	0.60	0.00
CAP	Captan	I	20.53960	6.45530	75.88707	71.37493	0.35	0.56	0.00
LUN	Linuron	H	10.76662	3.38379	41.96693	3.466693	0.35	0.55	0.05
DYR	Anilazine	F	1.68940	0.53095	7.28943		0.34	0.54	
BET	Bensulide	H	7.58457	2.38372	36.32268	98.73377	0.33	0.52	0.00
MAE	MCPA (unspecified ester)	H	2.43218	0.76440	12.3933	137.4831	0.33	0.51	0.00
FAD	Famoxadone	F	0.04482	0.01409	0.261764	1.375919	0.32	0.49	0.00
TRL	Triallate	H	1.16082	0.36483	7.149534	49.30737	0.32	0.48	0.00
PRO	Prometryne	H	7.79995	2.45141	53.21165	1.062662	0.31	0.47	0.13
PIR	Pirimicarb	I	1.75352	0.55111	14.75244	9623.818	0.30	0.44	0.00
FAA	N-Decanol	G	33.02333	10.37875	280.5273		0.30	0.43	

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
PYA	Pyraclostrobin	F	0.03386	0.01064	0.310533	0.837687	0.29	0.42	0.00
AMI	Amitrole	H	36.25179	11.39340	360.8317	19.37	0.29	0.41	0.00
QTZ	Quintozene	F	0.32507	0.10216	4.345944		0.27	0.35	
TZL	Thiabendazole	F	0.42509	0.13360	7.112371	618.674	0.25	0.31	0.00
MAN	Maneb	F	2.77253	0.87137	50.4081	35.97731	0.25	0.29	0.00
IPD	Iprodione	F	1.92112	0.60378	35.84712	11.20318	0.25	0.29	0.00
DXF	2,4-D (unspecified ester)	H	7.73452	2.43085	170.836	16.88155	0.24	0.25	0.00
BRY	Bromoxynil (octanoate)	H	0.20648	0.06489	4.715386	22.63561	0.23	0.24	0.00
DUR	Diuron	H	10.30875	3.23989	253.0239	5.504595	0.23	0.23	0.06
DXA	2,4-D (acid)	H	6.80313	2.13812	176.9515	412.4504	0.23	0.21	0.00
EFR	Ethalfluralin	H	0.43515	0.13676	11.43226	0.618674	0.23	0.21	0.00
EPT	EPTC	H	17.76795	5.58421	541.0226	473.4656	0.22	0.17	0.00
FLR	Fluroxypyr 1-methylheptyl ester	H	0.25445	0.07997	9.368749	37.35069	0.20	0.13	0.00
ZIN	Zineb	F	3.71224	1.16670	140.3832	123.7348	0.20	0.12	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
PIC	Picloram (form not specified)	H	6.82710	2.14566	281.3809	2790.765	0.20	0.10	0.00
BTL	Desmedipham	H	1.31817	0.41428	56.99572	27.76	0.19	0.08	0.00
TRF	Trifluralin	H	0.46351	0.14567	22.31434	6.834951	0.19	0.05	0.00
DCF	Dicofol	I	0.64922	0.20404	33.67	5.155617	0.18	0.03	0.00
DCB	Dichlobenil	H	29.67550	9.32657	1559.491	865.2675	0.18	0.03	0.00
TCM	2-(Thiocyanomethylthio) benzothiazole	F	0.01508	0.00474	0.830278		0.18	0.02	
DOD	Dodine (dodecylguanidine monoacetate)	F	0.16558	0.05204	9.198286	0.043995	0.18	0.01	0.00
TPM	Thiophanate-methyl	I	1.97923	0.62204	110.4786	394.3788	0.18	0.01	0.00
FLZ	Fluazinam	F	0.06085	0.01912	3.411882	13.04279	0.18	0.01	0.00
TFY	Trifloxystrobin	F	0.03191	0.01003	2.073739	2.957903	0.17	0.00	0.00
TFZ	Tebufenozide	I	0.34865	0.10958	22.8601	23.11353	0.17	0.00	0.00
ZOX	Zoxamide	F	0.13837	0.04349	9.293717	7.24	0.17	0.00	0.00
CNQ	Clomazone	H	2.25122	0.70752	153.8502	108.2671	0.17	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
AME	S-Metolachlor	H	4.24430	1.33392	303.6888	1.460991	0.16	0.00	0.00
KRB	Propyzamide	H	3.63652	1.14290	289.5899	501.48	0.16	0.00	0.00
VIL	Vinclozolin	F	1.11776	0.35130	98.49047	76.06506	0.15	0.00	0.00
CYP	Cyprodinil	F	0.37563	0.11806	33.21285	370.72	0.15	0.00	0.00
KRS	Kresoxim-methyl	F	0.12522	0.03935	12.33789	24.04204	0.14	0.00	0.00
MXF	Methoxyfenozide	I	0.34623	0.10882	34.5977	233.7213	0.14	0.00	0.00
NBP	Napropamide	H	12.29729	3.86486	1259.031		0.14	0.00	
NXI	Acetamiprid	I	0.24731	0.07773	28.65706	77.44583	0.13	0.00	0.00
MTL	Metolachlor	H	5.97405	1.87756	751.9997	33.10324	0.13	0.00	0.00
CHH	Boscalid	F	0.57616	0.18108	73.29423	107.4945	0.13	0.00	0.00
DPP	Diclofop-methyl	H	0.15910	0.05000	21.83825		0.12	0.00	
ATR	Atrazine	H	12.33595	3.87701	1701.025	12.00924	0.12	0.00	0.17
SMZ	Simazine	H	16.57424	5.20904	2289.028	24.63599	0.12	0.00	0.00
MEI	Dimethenamid	H	3.74345	1.17651	543.0473	8.794035	0.12	0.00	0.00
ENT	Endothall (form not specified)	H	2.81866	0.88586	540.04	103.1123	0.10	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
DIH	Dichlorprop (form not specified)	H	0.38154	0.11991	92.94977	17.8728	0.09	0.00	0.00
FAB	N-Octanol	G	7.26457	2.28315	1902.94	655.7526	0.08	0.00	0.00
FLT	Flufenacet	H	1.38520	0.43535	365.9217	0.035113	0.08	0.00	0.47
PEN	Pendimethalin	H	0.17203	0.05407	47.41507	0.753908	0.08	0.00	0.00
COD	Clothianidin	F	0.13715	0.04311	38.86273	4399.459	0.08	0.00	0.00
DXB	2,4-D (unspecified amine salt)	H	7.22749	2.27149	2236.699		0.07	0.00	
BAX	Metribuzin	H	6.98321	2.19472	2240.916	4.121292	0.07	0.00	0.08
DPA	Diphenylamine	G	0.10977	0.03450	35.32422	149.1692	0.07	0.00	0.00
FED	Fenamidone	F	0.10518	0.03306	36.49377	33.5843	0.06	0.00	0.00
ACP	Acephate	I	4.05459	1.27430	1469.213	15216.59	0.06	0.00	0.00
DIC	Dicamba (form not specified)	H	10.56283	3.31974	4084.148	30.93957	0.06	0.00	0.00
FEX	Fenhexamid	F	0.83698	0.26305	357.3299	347.6215	0.05	0.00	0.00
MYC	Myclobutanil	F	0.14141	0.04444	62.43289	99.82841	0.05	0.00	0.00
DPB	2,4-DB (form not specified)	H	3.44405	1.08241	1549.163		0.05	0.00	

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
TER	Terbacil	H	11.48643	3.61002	5453.616	5.749338	0.04	0.00	0.19
CUZ	Copper (copper hydroxide)	H	0.41925	0.13176	249.7064	2405.954	0.03	0.00	0.00
MTR	Metiram	F	0.24872	0.07817	152.3397	6.697126	0.03	0.00	0.00
DAZ	Dazomet	F	0.06733	0.02116	41.67331	17.74052	0.03	0.00	0.00
TPR	Triclopyr	H	12.26347	3.85423	8239.996	648.8695	0.02	0.00	0.00
TEU	Tebuconazole	F	0.11058	0.03475	77.91139	112.9859	0.02	0.00	0.00
AZY	Azoxystrobin	F	0.27800	0.08737	14.40767	0.128381	0.01	0.03	0.00
AMZ	Amitraz	I	0.43679	0.13728	339.0223	824.8987	0.01	0.00	0.00
VPR	Hexazinone	H	6.21316	1.95270	14560.96	0.801657	0.00	0.00	0.19
PAQ	Paraquat (form not specified)	H	0.05325	0.01674	1414.014	1.278172	0.00	0.00	0.06
FAL	Fosetyl-al	F	0.00004	0.00001	2101.761	489.6599	0.00	0.00	0.00
IDO	Iodosulfuron-methyl-sodium	H	0.00140	0.00044	5982.903	1.635495	0.00	0.00	0.00
FRA	Florasulam	H	0.00413	0.00130	11599.5	3.075971	0.00	0.00	0.00
TFS	Triflusulfuron methyl	H	0.03757	0.01181	59487.85	4.564375	0.00	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
DPY	Rimsulfuron	H	0.01314	0.00413	15919.48	119.855	0.00	0.00	0.00
CSL	Chlorsulfuron	H	0.01527	0.00480	11252.42	17.36393	0.00	0.00	0.00
PSF	Prosulfuron	H	0.01270	0.00399	8313.68	0.648507	0.00	0.00	0.00
NIO	Nicosulfuron	H	0.03513	0.01104	18589.95	13972.3	0.00	0.00	0.00
PID	Picloram (triisopropanolamine salt)	H	0.03862	0.01214	14004.43	16842.38	0.00	0.00	0.00
CFP	Clodinafop-propargyl	H	0.00473	0.00149	1489.051	1414.16	0.00	0.00	0.00
ETM	Ethametsulfuron (form not specified)	H	0.03233	0.01016	8473.793	178.728	0.00	0.00	0.00
SLF	Sulfosulfuron	H	0.03020	0.00949	6148.556	140.02	0.00	0.00	0.00
IMZ	Imazamox	H	0.03440	0.01081	6844.425	9.898784	0.00	0.00	0.00
HEC	Hexaconazole	F	0.00100	0.00031	188.5166	390.6795	0.00	0.00	0.00
CLM	Cloransulam (form not specified)	H	0.04846	0.01523	8702.49	556.7755	0.00	0.00	0.00
FLS	Flucarbazone-sodium	H	0.04359	0.01370	6754.35	2065.153	0.00	0.00	0.00
FLM	Flumetsulam	H	0.12967	0.04075	19452.94	71.41789	0.00	0.00	0.00
FMS	Foramsulfuron	H	0.04070	0.01279	6003.132	1929.666	0.00	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
MEX	Tribenuron methyl	H	0.31795	0.09993	44615.89	51.44147	0.00	0.00	0.00
PRI	Primisulfuron-methyl	H	0.04448	0.01398	4550.065	11.75672	0.00	0.00	0.00
FLD	Fludioxonil	F	0.00008	0.00002	7.024344	13.56404	0.00	0.00	0.00
CUS	Copper (copper sulphate)	H	0.00066	0.00021	54.71	2.814309	0.00	0.00	0.00
TRS	Triasulfuron	H	0.03573	0.01123	2873.269	20.89562	0.00	0.00	0.00
CLE	Clethodim	H	0.11905	0.03742	7435.981	1486.124	0.00	0.00	0.00
MEM	Metsulfuron-methyl	H	0.17940	0.05638	9294.977	2.598024	0.00	0.00	0.00
FOF	Fomesafen	H	0.47379	0.14890	19301.35	6.607776	0.00	0.00	0.00
PZN	Pymetrozine	I	0.02968	0.00933	1203.504	1035.356	0.00	0.00	0.00
TRA	Tralkoxydim	H	0.25570	0.08036	8597.504	1797.113	0.00	0.00	0.00
DPI	Clopyralid	H	0.42343	0.13308	14157.69	474.3167	0.00	0.00	0.00
IMP	Imazethapyr	H	2.67808	0.84168	61966.51	4069.5	0.00	0.00	0.00
TRT	Triticonazole	F	0.00521	0.00164	119.318	244.3774	0.00	0.00	0.00
SPI	Spinosad	I	0.00859	0.00270	151.5678	39.11465	0.00	0.00	0.00
QUC	Quinclorac	H	0.24509	0.07703	4246.817	2997.132	0.00	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
DFF	Diflufenzopyr (form not specified)	H	0.07358	0.02312	1043.359	84.96163	0.00	0.00	0.00
VIT	Carbathiin	F	0.07743	0.02434	1094.166	52.25874	0.00	0.00	0.00
MMM	Thifensulfuron-methyl	H	3.06617	0.96365	42482.1	0.584458	0.00	0.00	0.00
BAD	6-Benzyladenine	G	0.07409	0.02329	984.3149	6874.155	0.00	0.00	0.00
FPF	Fenoxaprop-p-ethyl	H	0.01181	0.00371	132.4387	43.53249	0.00	0.00	0.00
THE	Thiamethoxam	F	0.04261	0.01339	426.6308	6667.931	0.00	0.00	0.00
BMS	Flusilazole	F	0.01359	0.00427	130.6443	439.9459	0.00	0.00	0.00
DFZ	Difenoconazole	F	0.00493	0.00155	46.3308	82.48987	0.00	0.00	0.00
FZA	Fluazifop-p-butyl	H	0.04392	0.01380	409.4662	81.26891	0.00	0.00	0.00
SOD	Sethoxydim	H	0.75051	0.23587	6521.097	20.82869	0.00	0.00	0.00
ASS	Imazamethabenz (form not specified)	H	1.14806	0.36082	9191.119	8730.177	0.00	0.00	0.00
MER	Mesotrione	H	0.27167	0.08538	2118.298	2831.125	0.00	0.00	0.00
MTA	Metalaxyl	F	0.07456	0.02343	538.7747	2955.887	0.00	0.00	0.00
ETF	Ethephon	G	1.22317	0.38442	7817.445	2199.73	0.00	0.00	0.00
PFN	Picolinafen	H	0.00529	0.00166	32.51914	0.2451	0.00	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
GPI	Glyphosate (isopropylamine salt)	H	0.75622	0.23767	4642.997	507.1424	0.00	0.00	0.00
PON	Propiconazole	F	0.18564	0.05835	863.58	11.25	0.00	0.00	0.00
DIQ	Diquat (form not specified)	H	0.03584	0.01126	154.7506	8.065215	0.00	0.00	0.00
DME	Dimethomorph	F	0.26864	0.08443	1088.913	1652.783	0.00	0.00	0.00
ACA	Acifluorfen (form not specified)	H	1.29752	0.40779	4771.421	17872.8	0.00	0.00	0.00
TLL	Triadimenol	F	0.02690	0.00845	96.06198	236.5349	0.00	0.00	0.00
PHY	Propamocarb hydrochloride	F	2.02141	0.63530	6429.697	30864.88	0.00	0.00	0.00
CCC	Chlormequat (form not specified)	G	2.95633	0.92913	9150.905	391917.5	0.00	0.00	0.00
GPS	Glyphosate (acid)	H	1.17087	0.36799	3423.424	6955.61	0.00	0.00	0.00
GLG	Glufosinate ammonium	H	1.71667	0.53952	4511.633	536.1841	0.00	0.00	0.00
CYO	Cymoxanil	F	0.30212	0.09495	744.569	36.35254	0.00	0.00	0.00
OXR	Oxyfluorfen	H	0.08823	0.02773	169.0221	0.021278	0.00	0.00	0.00
MAA	MCPA (acid)	H	4.53451	1.42513	8379.447	10275.43	0.00	0.00	0.00
MAH	Maleic hydrazide (form not specified)	H	6.43279	2.02173	11387.48	23144.69	0.00	0.00	0.00

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
BZN	Bentazon (form not specified)	H	2.83871	0.89217	4918.285	2777.189	0.00	0.00	0.00
IXF	Isoxaflutole	H	0.09097	0.02859	134.2534	13.24777	0.00	0.00	0.00
GPT	Glyphosate (trimethylsulfonium salt)	H	0.51780	0.16274	743.5981	271.0894	0.00	0.00	0.00
TRR	Triforine	F	1.10671	0.34782	1493.412	20691.21	0.00	0.00	0.00
PYZ	Pyrazon (chloridazon)	H	10.59126	3.32868	13869.98	33.27364	0.00	0.00	0.00
MAB	MCPA (dimethylammine salt)	H	6.80364	2.13828	8379.447	3260.108	0.00	0.00	0.00
CHL	Chlorthal (form not specified)	H	5.08494	1.59812	6196.651	738.3527	0.00	0.00	0.00
MBS	MCPB (sodium salt)	H	2.86419	0.90017	3408.158	52.57174	0.00	0.00	0.00
MAS	MCPA (potassium salt)	H	7.57473	2.38063	8379.447	3260.108	0.00	0.00	0.00
MFN	Metalaxyl-m (mefenoxam)	F	1.52751	0.48007	1676.926	4185.903	0.00	0.00	0.00
PMP	Phenmedipham	H	0.12454	0.03914	124.9491	6.014002	0.00	0.00	0.00
MEZ	Mecoprop d-isomer (amine salt)	H	1.38522	0.43535	5576.986		0.00	0.00	
MEC	Mecoprop (form not specified)	H	2.15268	0.67656	5576.986		0.00	0.00	

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
MEW	Mecoprop d-isomer (potassium salt)	H	2.74483	0.86266	5576.986		0.00	0.00	
MEA	Mecoprop (potassium salt)	H	3.06279	0.96259	5576.986		0.00	0.00	
FBZ	Indar	F	0.02868	0.00901	46.25362		0.00	0.00	
QPE	Quizalofop p-ethyl	H	0.01583	0.00498	17.97029		0.00	0.00	
NAA	1-Naphthalene actetic acid (form not specified)	G	0.00000	0.00000	9781.355		0.00	0.00	
GPP	Glyphosate (potassium salt)	H	1.00119	0.31466	4.83E+09		0.00	0.00	
AMN	Aminoethoxyvinylglycine	G	0.03467	0.01089	5187.347		0.00	0.00	
TPA	Tepraloxydim	H	0.07201	0.02263	7435.981		0.00	0.00	
CHE	Chlorimuron-ethyl	H	0.01034	0.00325	619.6651		0.00	0.00	
GPM	Glyphosate (mono-ammonium salt)	H	1.00919	0.31717	48333.88		0.00	0.00	
CUY	Copper (copper oxychloride)	F	0.00017	0.00005	7.329837		0.00	0.00	
SUL	Sulphur	I	1.03797	0.32622	29259.41		0.00	0.00	
FOR	Formaldehyde	F	2.56355	0.80569	32228.73		0.00	0.00	

Table 18: Results from all three empirically derived aquatic models: Crustacea count ratio, the most conservative abundance model (Cladocera or Copepoda), and the algal model. HC5 values are also given as well as the estimated water concentrations for both puddle and pond scenarios.

AI Code	AI Accepted Name	Type	Puddle Concentration (ug/L)	Pond Concentration (ug/L)	HC5 Crustaceans (ug/L)	HC5 Algae (ug/L)	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio
PYR	Pyrethrins	I	0.00046	0.00014	1.52		0.00	0.00	
CYZ	Cyromazine	I	0.47546	0.14943	852.0973		0.00	0.00	
AVG	Difenzoquat (methyl sulphate salt)	H	0.09567	0.03007	159.8436		0.00	0.00	
NAP	Naptalam (form not specified)	H	5.24914	1.64973	7343.031		0.00	0.00	
MPR	(S)-Methoprene	I	0.02862	0.00899	35.43212		0.00	0.00	
CFZ	Clofentezine	I	0.02770	0.00871		2199.73			0.00
ETS	Ethofumesate	H	10.92715	3.43424					

15 ALL 206 ACTIVE INGREDIENTS USED ON CROPS IN CANADA, RANKED ACCORDING TO TOXICITY TO FISH.

This table shows the accumulated number of fish kill incidents, along with a risk score reflecting the cumulative number of kills for ranked ETR values. This was accomplished by dividing the PRZM-corrected GENEEC 96-hour predicted exposure concentration by the HC5 fish toxicity to create a fish exposure toxicity ratio (ETR) (see Mineau *et al.*, 2008 for details).

Four hundred and thirty-eight fish kill records were compiled from a number of sources and related to the list of pesticides covered in the ranking exercise. Forty-eight out of 206 pesticides have an associated incident or incidents and, despite their heavy concentration in the top ranks of our fish hazard compilation, they are distributed throughout our rankings.

A provisional fish standard is proposed based on the USEPA record of pesticide fish kills. Pesticide active ingredients will be considered to have met the standard if their relative risk to fish (calculated from a risk quotient based on exposure modeling and a fish HC5 value) is such that all pesticides of same or lesser hazard are responsible for no more than 10% of all fish kills recorded by the USEPA.

A group of the worst 11 pesticides are responsible for 50% of all fish kills. These should be red-listed compounds. We recognize that this is a preliminary step at validating our risk-based ranking with actual recorded ecological incidents, given that the incident data is only a partial representation of what is happening in the field (because many incidents are not reported or observed); nevertheless, we believe that the risk indices as defined here could form the basis of workable protection standards, whether ideal or currently achievable.

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
TEL	Tefluthrin	0.010082	0.305507	30.30321	1	7	438	1.00
PHR	Phorate	0.638715	2.520492	3.946191	2	10	431	0.98
THI	Thiram	1.91179	3.486027	1.823436	3		421	0.96
ESF	Endosulfan	0.36	0.312885	0.869125	4	58	421	0.96
GOO	Azinphos-methyl	1.24	0.74613	0.601718	5	98	363	0.83
DUB	Chlorpyrifos	0.966203	0.52353	0.541843	6	26	265	0.61
ZIR	Ziram	8.688348	4.373067	0.503325	7		239	0.55
CAP	Captan	24.86972	6.455295	0.259564	8		239	0.55
TET	Chlorothalonil	18.0612	4.192978	0.232154	9	6	239	0.55
FER	Ferbam	18.40964	4.26341	0.231586	10		233	0.53
COY	Terbufos	1.414292	0.243375	0.172082	11	67	233	0.53
FOL	Folpet	25.26882	3.917137	0.155019	12		166	0.38
DIM	Dimethoate	12.58821	1.869961	0.148549	13	1	166	0.38
DIA	Diazinon	56.92008	5.456379	0.09586	14	7	165	0.38
DIN	Dinocap	1.777245	0.098293	0.055306	15		158	0.36

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
PFL	Permethrin	1.84	0.095949	0.052146	16	4	158	0.36
PRT	Phosmet[1]	14.68234	0.672948	0.045834	17		154	0.35
CYM	Cypermethrin	0.722092	0.031865	0.044129	18	2	154	0.35
DYR	Anilazine	15.03	0.530955	0.035326	19		152	0.35
NAL	Naled	16.60563	0.441525	0.026589	20		152	0.35
PYD	Pyridaben	0.521973	0.012233	0.023436	21		152	0.35
DIK	Dichloran	787.9699	16.05198	0.020371	22		152	0.35
CYH	Cyhalothrin-lambda	0.01812	0.00027	0.014913	23	5	152	0.35
CAF	Carbofuran	72.34381	1.06802	0.014763	24	5	147	0.34
ETS	Ethofumesate	237.2179	3.434241	0.014477	25		142	0.32
FAA	N-Decanol	727.0156	10.37875	0.014276	26	1	142	0.32
DBR	Deltamethrin	0.254104	0.000247	0.013739	27		141	0.32
DXF	2,4-D (unspecified ester)	221.0687	2.430846	0.010996	28	9	141	0.32
MET	Methoxychlor	7.788472	0.081427	0.010455	29		132	0.30
BET	Bensulide	239.7195	2.383719	0.009944	30		132	0.30

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
CAB	Carbaryl	933.2764	7.602054	0.008146	31	2	132	0.30
EFR	Ethalfluralin	21.15266	0.136763	0.006466	32		130	0.30
TRI	Trichlorfon	464.2122	2.780616	0.00599	33		130	0.30
MAN	Maneb	164.4501	0.871367	0.005299	34	1	130	0.30
FAD	Famoxadone	2.761243	0.014088	0.005102	35		129	0.29
BRY	Bromoxynil (octanoate)	15.08526	0.064895	0.004302	36		129	0.29
MOR	Chinomethionat	14.89832	0.060734	0.004077	37		129	0.29
CHL	Chlorthal (form not specified)	392.3547	1.598122	0.004073	38		129	0.29
PYA	Pyraclostrobin	2.654344	0.010643	0.00401	39		129	0.29
TPR	Triclopyr	1082.65	3.854228	0.00356	40	1	129	0.29
TRF	Trifluralin	45.99077	0.145674	0.003167	41		128	0.29
ATR	Atrazine	1241.949	3.877008	0.003122	42	26	128	0.29
MML	Methomyl	610.4072	1.741506	0.002853	43	1	102	0.23
DCF	Dicofol	72.76077	0.204041	0.002804	44		101	0.23
KRB	Propyzamide	446.8533	1.142904	0.002558	45		101	0.23

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
LUN	Linuron	1329.532	3.38379	0.002545	46		101	0.23
BTL	Desmedipham	168.3062	0.414282	0.002461	47		101	0.23
AME	S-Metolachlor	567.3097	1.333922	0.002351	48		101	0.23
DUR	Diuron	1456.106	3.239887	0.002225	49	3	101	0.23
FOM	Formetanate (form not specified)	1363.868	2.837745	0.002081	50		98	0.22
SMZ	Simazine	2885.838	5.20904	0.001805	51	2	98	0.22
PRO	Prometryne	1369.15	2.451411	0.00179	52		96	0.22
MCZ	Mancozeb	807.4789	1.436039	0.001778	53		96	0.22
NBP	Napropamide	2194.9	3.864858	0.001761	54		96	0.22
FLR	Fluroxypyr 1-methylheptyl ester	48.1608	0.07997	0.00166	55		96	0.22
FLZ	Fluazinam	11.96593	0.019124	0.001598	56		96	0.22
QTZ	Quintozene	66.31783	0.102165	0.001541	57		96	0.22
DCB	Dichlobenil	6093.499	9.326571	0.001531	58		96	0.22
PHS	Phosalone	67.79089	0.100967	0.001489	59		96	0.22

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
TCM	2-(Thiocyanomethylthio) benzothiazole	3.210743	0.004738	0.001476	60		96	0.22
MEI	Dimethenamid	826.9155	1.176512	0.001423	61	1	96	0.22
MAL	Malathion	48.2	0.061311	0.001272	62	11	95	0.22
TFZ	Tebufenozide	86.39235	0.109576	0.001268	63		84	0.19
MAE	MCPA (unspecified ester)	687.7275	0.764398	0.001111	64		84	0.19
DPB	2,4-DB (form not specified)	974.9441	1.082413	0.00111	65		84	0.19
OXB	Oxamyl	1787.49	1.982168	0.001109	66		84	0.19
TRL	Triallate	348.22	0.364829	0.001048	67		84	0.19
DIC	Dicamba (form not specified)	3227	3.319741	0.001029	68	2	84	0.19
MAA	MCPA (acid)	1822.671	1.425129	0.000782	69		82	0.19
FLT	Flufenacet	591.6008	0.435348	0.000736	70		82	0.19
TFY	Trifloxystrobin	14.46633	0.01003	0.000693	71		82	0.19
ZIN	Zineb	1916.127	1.166703	0.000609	72		82	0.19
PIC	Picloram (form not specified)	3532.166	2.145658	0.000607	73	2	82	0.19

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
FEX	Fenhexamid	499.0074	0.26305	0.000527	74		80	0.18
OXR	Oxyfluorfen	53.69376	0.027728	0.000516	75		80	0.18
DPP	Diclofop-methyl	103.8114	0.050003	0.000482	76	1	80	0.18
MTL	Metolachlor	3951.96	1.877557	0.000475	77	18	79	0.18
DIH	Dichlorprop (form not specified)	254.6097	0.119913	0.000471	78		61	0.14
CHH	Boscalid	399.7441	0.181078	0.000453	79		61	0.14
KRS	Kresoxim-methyl	97.43908	0.039355	0.000404	80		61	0.14
CUZ	Copper (copper hydroxide)	363.7119	0.131763	0.000362	81	8	61	0.14
AZY	Azoxystrobin	242.5976	0.087372	0.00036	82		53	0.12
EPT	EPTC	16888.87	5.584205	0.000331	83	1	53	0.12
AMZ	Amitraz	425.1773	0.137275	0.000323	84		52	0.12
MXF	Methoxyfenozide	371.0895	0.108816	0.000293	85		52	0.12
PYZ	Pyrazon (chloridazon)	11356.01	3.328677	0.000293	86		52	0.12
PEN	Pendimethalin	194.3251	0.054065	0.000278	87	2	52	0.12
DXA	2,4-D (acid)	7733.591	2.138122	0.000276	88		50	0.11

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
ZOX	Zoxamide	157.99	0.043488	0.000275	89		50	0.11
DAZ	Dazomet	79.02	0.021162	0.000268	90		50	0.11
MBS	MCPB (sodium salt)	3546.429	0.900173	0.000254	91		50	0.11
IPD	Iprodione	2403.589	0.603781	0.000251	92		50	0.11
TER	Terbacil	14639.93	3.610016	0.000247	93		50	0.11
CNQ	Clomazone	3375.143	0.707524	0.00021	94	2	50	0.11
CYP	Cyprodinil	571.2081	0.118055	0.000207	95		48	0.11
AMI	Amitrole	58634.04	11.3934	0.000194	96		48	0.11
SOD	Sethoxydim	1263.996	0.235873	0.000187	97	2	48	0.11
VIL	Vinclozolin	1966.346	0.351297	0.000179	98		46	0.11
BAX	Metribuzin	12465.63	2.19472	0.000176	99	1	46	0.11
FAB	N-Octanol	13250.76	2.283148	0.000172	100		45	0.10
TPM	Thiophanate-methyl	3668.126	0.622043	0.00017	101		45	0.10
TZL	Thiabendazole	794.1434	0.1336	0.000168	102		45	0.10
ENT	Endothall (form not specified)	5504.105	0.885862	0.000161	103		45	0.10

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
MAS	MCPA (potassium salt)	14928.72	2.380625	0.000159	104		45	0.10
NAP	Naptalam (form not specified)	10895.98	1.649726	0.000151	105		45	0.10
GPI	Glyphosate (isopropylamine salt)	1587.364	0.237668	0.00015	106	5	45	0.10
MAB	MCPA (dimethylammine salt)	14928.72	2.138285	0.000143	107		40	0.09
GPT	Glyphosate (trimethylsulfonium salt)	1446.458	0.162736	0.000113	108	5	40	0.09
VIT	Carbathiin	232.1116	0.024335	0.000105	109		35	0.08
MAH	Maleic hydrazide (form not specified)	21141.11	2.021731	9.56E-05	110		35	0.08
ACP	Acephate	13673.22	1.274298	9.32E-05	111	2	35	0.08
FED	Fenamidone	358.3476	0.033056	9.22E-05	112		33	0.08
MTR	Metiram	863.2631	0.07817	9.06E-05	113		33	0.08
MYC	Myclobutanil	494.679	0.044443	8.98E-05	114		33	0.08
DPA	Diphenylamine	398.3258	0.034498	8.66E-05	115		33	0.08
PIR	Pirimicarb	7149.015	0.551107	7.71E-05	116		33	0.08

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
FOR	Formaldehyde	10706.42	0.805687	7.53E-05	117		33	0.08
DOD	Dodine (dodecylguanidine monoacetate)	694.7599	0.05204	7.49E-05	118		33	0.08
ACA	Acifluorfen (form not specified)	5445.689	0.407791	7.49E-05	119		33	0.08
GPP	Glyphosate (potassium salt)	4522.562	0.31466	6.96E-05	120	5	33	0.08
QPE	Quizalofop p-ethyl	80.44451	0.004975	6.18E-05	121		28	0.06
FZA	Fluazifop-p-butyl	224.8568	0.013804	6.14E-05	122	1	28	0.06
DME	Dimethomorph	1458.589	0.084429	5.79E-05	123		27	0.06
MMM	Thifensulfuron-methyl	16773.84	0.963653	5.74E-05	124		27	0.06
FBZ	Indar	163.5964	0.009012	5.51E-05	125		27	0.06
MOM	Methamidophos	16050.5	0.756686	4.71E-05	126		27	0.06
PMP	Phenmedipham	833.4238	0.03914	4.7E-05	127		27	0.06
TRA	Tralkoxydim	1800.575	0.080361	4.46E-05	128		27	0.06
MEA	Mecoprop (potassium salt)	22583.84	0.962589	4.26E-05	129		27	0.06
MEW	Mecoprop d-isomer (potassium salt)	22583.84	0.862659	3.82E-05	130		27	0.06

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
MFN	Metalaxyl-m (mefenoxam)	15038.23	0.480074	3.19E-05	131		27	0.06
PYR	Pyrethrins	4.578177	0.000144	3.14E-05	132		27	0.06
MEC	Mecoprop (form not specified)	22583.84	0.676555	3E-05	133		27	0.06
PON	Propiconazole	1953.642	0.058345	2.99E-05	134		27	0.06
CFP	Clodinafop-propargyl	64.1188	0.001486	2.32E-05	135		27	0.06
BMS	Flusilazole	195.2626	0.004271	2.19E-05	136		27	0.06
CCC	Chlormequat (form not specified)	43171.42	0.929131	2.15E-05	137		27	0.06
IXF	Isoxaflutole	1401.795	0.028592	2.04E-05	138		27	0.06
PFN	Picolinafen	83.72858	0.001664	1.99E-05	139		27	0.06
MEZ	Mecoprop d-isomer (amine salt)	22583.84	0.435355	1.93E-05	140		27	0.06
VPR	Hexazinone	102277.7	1.952704	1.91E-05	141		27	0.06
TRR	Triforine	19514.87	0.347822	1.78E-05	142		27	0.06
DXB	2,4-D (unspecified amine salt)	130354.8	2.271494	1.74E-05	143		27	0.06
CYZ	Cyromazine	9401.361	0.14943	1.59E-05	144		27	0.06

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
IMP	Imazethapyr	54656.37	0.841681	1.54E-05	145		27	0.06
BZN	Bentazon (form not specified)	64444.81	0.892166	1.38E-05	146		27	0.06
CFZ	Clofentezine	683.5559	0.008707	1.27E-05	147		27	0.06
ASS	Imazamethabenz (form not specified)	31062.35	0.360819	1.16E-05	148		27	0.06
FPF	Fenoxaprop-p-ethyl	351.38	0.003711	1.06E-05	149	1	27	0.06
ETF	Ethephon	38350.14	0.384423	1E-05	150		26	0.06
DFZ	Difenoconazole	162.9	0.001549	9.51E-06	151		26	0.06
SUL	Sulphur	35836.98	0.326218	9.1E-06	152		26	0.06
IMI	Imidacloprid	15989.45	0.14468	9.05E-06	153		26	0.06
GPS	Glyphosate (acid)	42909.93	0.367986	8.58E-06	154	5	26	0.06
PHY	Propamocarb hydrochloride	78747.33	0.635299	8.07E-06	155		21	0.05
NXI	Acetamiprid	10643.07	0.077727	7.3E-06	156		21	0.05
GPM	Glyphosate (mono-ammonium salt)	45225.62	0.317174	7.01E-06	157	5	21	0.05
DPI	Clopyralid	19109.59	0.133077	6.96E-06	158		16	0.04

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
TEU	Tebuconazole	5005.44	0.034753	6.94E-06	159	1	16	0.04
SLF	Sulfosulfuron	1414.5	0.009491	6.71E-06	160		15	0.03
BAD	6-Benzyladenine	3603.849	0.023287	6.46E-06	161		15	0.03
MPR	(S)-Methoprene	1398.854	0.008993	6.43E-06	162		15	0.03
CYO	Cymoxanil	15002.97	0.094952	6.33E-06	163		15	0.03
CLE	Clethodim	6953.675	0.037415	5.38E-06	164		15	0.03
CHE	Chlorimuron-ethyl	687.5229	0.003249	4.73E-06	165		15	0.03
COD	Clothianidin	10539.89	0.043106	4.09E-06	166		15	0.03
PAQ	Paraquat (form not specified)	4927.248	0.016737	3.4E-06	167		15	0.03
MER	Mesotrione	27289.19	0.085381	3.13E-06	168		15	0.03
CUS	Copper (copper sulphate)	76.85882	0.000208	2.71E-06	169	3	15	0.03
SPI	Spinosad	1123.262	0.0027	2.4E-06	170		12	0.03
MTA	Metalaxyl	10771.52	0.023432	2.18E-06	171	1	12	0.03
MEM	Metsulfuron-methyl	27395.43	0.056382	2.06E-06	172		11	0.03
QUC	Quinclorac	40486.93	0.077027	1.9E-06	173		11	0.03

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
GLG	Glufosinate ammonium	299429.1	0.539525	1.8E-06	174		11	0.03
DIQ	Diquat (form not specified)	6272.188	0.011265	1.8E-06	175	2	11	0.03
FOF	Fomesafen	84985.62	0.148905	1.75E-06	176		9	0.02
TRT	Triticonazole	1108.657	0.001638	1.48E-06	177		9	0.02
TPA	Tepraloxydim	16318.79	0.022631	1.39E-06	178		9	0.02
AVG	Difenzoquat (methyl sulphate salt)	23898.76	0.030067	1.26E-06	179		9	0.02
THE	Thiamethoxam	10854.16	0.013391	1.23E-06	180		9	0.02
PRI	Primisulfuron-methyl	12004.51	0.013981	1.16E-06	181		9	0.02
DFF	Diflufenzopyr (form not specified)	21044.51	0.023125	1.1E-06	182		9	0.02
FLS	Flucarbazone-sodium	16436.92	0.013701	8.34E-07	183		9	0.02
PID	Picloram (triisopropanolamine salt)	15126.34	0.012139	8.03E-07	184		9	0.02
FMS	Foramsulfuron	16572.35	0.012792	7.72E-07	185		9	0.02
CLM	Cloransulam (form not specified)	21875.14	0.015231	6.96E-07	186		9	0.02

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
CUY	Copper (copper oxychloride)	79.45036	5.22E-05	6.56E-07	187	8	9	0.02
TRS	Triasulfuron	17158.37	0.01123	6.54E-07	188		1	0.00
TLL	Triadimenol	13326.36	0.008453	6.34E-07	189		1	0.00
MEX	Tribenuron methyl	167738.4	0.099927	5.96E-07	190		1	0.00
IMZ	Imazamox	18618.8	0.01081	5.81E-07	191		1	0.00
AMN	Aminoethoxyvinylglycine	19002.85	0.010895	5.73E-07	192		1	0.00
HEC	Hexaconazole	731.3463	0.000313	4.29E-07	193		1	0.00
NIO	Nicosulfuron	47755.55	0.011042	2.31E-07	194		1	0.00
PSF	Prosulfuron	23487.04	0.003992	1.7E-07	195		1	0.00
CSL	Chlorsulfuron	28279.03	0.004798	1.7E-07	196		1	0.00
FLM	Flumetsulam	281341.6	0.040755	1.45E-07	197		1	0.00
ETM	Ethametsulfuron (form not specified)	71165.38	0.010161	1.43E-07	198		1	0.00
PZN	Pymetrozine	94653.01	0.009327	9.85E-08	199		1	0.00
TFS	Triflusulfuron methyl	121272.9	0.011807	9.74E-08	200		1	0.00

Table 19: All 206 active ingredients used on crops in Canada, ranked according to toxicity to fish. The accumulated number of fish kill is given along with a risk score reflecting the cumulative number of kills for ranked ETR values.

AI Code	AI Accepted Name	HC5 Fish (ug/L)	Pond Concentration (ug/L)	Fish ETR	Rank	US EPA EIIS / California Fish Incident Data	Cumulative Fish Kills	Risk score
DPY	Rimsulfuron	42901.57	0.004129	9.62E-08	201		1	0.00
FLD	Fludioxonil	268.0696	2.36E-05	8.82E-08	202		1	0.00
FRA	Florasulam	17923.35	0.001299	7.25E-08	203		1	0.00
IDO	Iodosulfuron-methyl-sodium	16196.7	0.000439	2.71E-08	204		1	0.00
FAL	Fosetyl-al	15209.9	1.34E-05	8.79E-10	205	1	1	0.00
NAA	1-Naphthalene actetic acid (form not specified)	3980.784	7.56E-08	1.9E-11	206		0	0.00

16 AMALGAMATED RISK SCORES FOR ALL PESTICIDE LIQUID APPLICATIONS AT MAXIMUM LABEL RATE. ALL GREY SHADED AREAS REPRESENT A PESTICIDE USED AS PARTICULATE ONLY (SEED TREATMENT OR GRANULAR APPLICATION).

The following table summarises the various risk scores for all 206 pesticides included in our sample when used at maximum label rate (see Mineau *et al.*, 2008 for details). The three letter formal active ingredient codes (PMRA, pers. comm.) are listed in alphabetical order. The red-yellow-green labelling system has been described in previous sections as well as in Mineau *et al.* (2008). Greyed cells indicate that the product is a granular or seed treatment pesticide and those scores are given in the tables that follow.

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
ACA	Acifluorfen (form not specified)	62476599	Herbicide	0.6000	0.01	0.18	0.00	no data	0.00	0.00	0.00	0.08
ACP	Acephate	30560191	Insecticide	2.5500	0.98	0.19	0.33	0.67	0.06	0.00	0.00	0.08
AME	S-Metolachlor	87392129	Herbicide	1.6013	0.01	0.00	0.00	0.22	0.16	0.00	0.00	0.23
AMI	Amitrole	61825	Herbicide	10.6300	0.04	0.29	0.02	0.51	0.29	0.41	0.00	0.11
AMN	Aminoethoxyvinylglycine	55720268	Growth Regulator	0.1250	0.02	no data	no data	no data	0.00	0.00	no data	0.00
AMZ	Amitraz	33089611	Insecticide	1.6750	0.08	0.07	0.01	0.28	0.01	0.00	0.00	0.12
ASS	Imazamethabenz (form not specified)		Herbicide	0.4998	0.01	no data	0.00	0.14	0.00	0.00	0.00	0.06
ATR	Atrazine	1912249	Herbicide	4.0000	0.02	0.19	0.23	0.33	0.12	0.00	0.17	0.29
AVG	Difenzoquat (methyl sulphate salt)	43222486	Herbicide	0.8500	0.01	no data	1.00	0.28	0.00	0.00	no data	0.02
AZY	Azoxystrobin	1.32E+08	Fungicide	0.2813	0.00	0.00	0.00	0.03	0.01	0.03	0.00	0.12
BAD	6-Benzyladenine	1214397	Growth Regulator	0.0763	0.00	no data	0.00	0.10	0.00	0.00	0.00	0.03
BAX	Metribuzin	21087649	Herbicide	2.2500	0.11	0.22	0.43	0.32	0.07	0.00	0.08	0.11

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
BET	Bensulide	741582	Herbicide	6.7200	0.08	1.00	1.00	0.50	0.33	0.52	0.00	0.30
BMS	Flusilazole	85509199	Fungicide	0.0400	0.00	no data	0.00	0.00	0.00	0.00	0.00	0.06
BRY	Bromoxynil (octanoate)	1689992	Herbicide	0.3375	0.00	0.00	0.02	0.28	0.23	0.24	0.00	0.29
BTL	Desmedipham	13684565	Herbicide	0.7125	0.01	0.07	0.00	0.21	0.19	0.08	0.00	0.23
BZN	Bentazon (form not specified)	25057890	Herbicide	1.0800	0.07	0.10	0.00	no data	0.00	0.00	0.00	0.06
CAB	Carbaryl	63252	Insecticide	9.8040	0.00	0.23	0.96	0.69	0.59	0.89	0.00	0.30
CAF	Carbofuran	1563662	Insecticide	1.2000	1.00	0.17	0.80	0.78	0.62	0.90	0.00	0.34
CAP	Captan	133062	Fungicide	12.5000	0.51	0.10	0.01	0.43	0.35	0.56	0.00	0.55
CCC	Chlormequat (form not specified)	999815	Growth Regulator	1.3800	0.05	no data	0.97	no data	0.00	0.00	0.00	0.06
CFP	Clodinafop-propargyl	1.06E+08	Herbicide	0.0696	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
CFZ	Clofentezine	74115245	Insecticide	0.3000	0.00	0.07	0.00	0.24	no data	no data	0.00	0.06
CHE	Chlorimuron-ethyl	90982324	Herbicide	0.0090	0.00	0.00	0.00	0.00	0.00	0.00	no data	0.03

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
CHH	Boscalid	1.88E+08	Fungicide	0.5390	0.00	0.00	no data	no data	0.13	0.00	0.00	0.14
CHL	Chlorthal (form not specified)	1861321	Herbicide	13.5000	0.10	no data	0.00	no data	0.00	0.00	0.00	0.29
CLE	Clethodim	99129212	Herbicide	0.0912	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
CLM	Cloransulam (form not specified)	1.47E+08	Herbicide	0.0350	0.00	no data	0.00	0.03	0.00	0.00	0.00	0.02
CNQ	Clomazone	81777891	Herbicide	1.1160	0.01	0.00	0.00	0.21	0.17	0.00	0.00	0.11
COD	Clothianidin	2.11E+08	Insecticide	0.0834					0.08	0.00	0.00	0.03
COY	Terbufos		Insecticide						0.52	0.83	no data	0.53
CSL	Chlorsulfuron	64902723	Herbicide	0.0113	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CUS	Copper (copper sulphate)	7758987	Algicide, Fungicide	0.0083	0.00	no data	no data	no data	0.00	0.00	0.00	0.03
CUY	Copper (copper oxychloride)	1332407	Fungicide	4.5000	0.18	no data	no data	no data	0.00	0.00	no data	0.02
CUZ	Copper (copper hydroxide)	20427592	Fungicide	2.2500	0.02	1.00	1.00	0.27	0.03	0.00	0.00	0.14
CYH	Cyhalothrin-lambda	91465086	Insecticide	0.0229	0.00	0.00	0.00	0.47	0.71	0.73	0.00	0.35

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
CYM	Cypermethrin	52315078	Insecticide	0.9497	0.00	0.21	0.04	0.91	0.60	0.90	0.00	0.35
CYO	Cymoxanil		Fungicide	0.2100	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.03
CYP	Cyprodinil	1.22E+08	Fungicide	0.5625	0.01	0.00	0.00	0.06	0.15	0.00	0.00	0.11
CYZ	Cyromazine	66215278	Insecticide	0.2798	0.00	0.00	0.00	0.05	0.00	0.00	no data	0.06
DAZ	Dazomet	533744	Multipurpose	0.0490					0.03	0.00	0.00	0.11
DBR	Deltamethrin	52918635	Insecticide	0.0200	0.00	0.00	0.00	0.67	0.39	0.64	0.00	0.32
DCB	Dichlobenil	1194656	Herbicide	9.0000	0.20	0.30	0.69	0.59	0.18	0.03	0.00	0.22
DCF	Dicofol	115322	Insecticide	2.5500	0.07	0.39	0.09	0.35	0.18	0.03	0.00	0.23
DFF	Diflufenzopyr (form not specified)	1.09E+08	Herbicide	0.0570	0.00	no data	no data	0.00	0.00	0.00	0.00	0.02
DFZ	Difenoconazole	1.19E+08	Fungicide	0.0263					0.00	0.00	0.00	0.06
DIA	Diazinon	333415	Insecticide	11.6000	1.00	0.44	0.94	0.93	0.71	0.95	0.00	0.38
DIC	Dicamba (form not specified)	1918009	Herbicide	3.4293	0.11	0.11	0.37	0.32	0.06	0.00	0.00	0.19

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
DIH	Dichlorprop (form not specified)	53404312	Herbicide	0.5250	0.02	no data	no data	0.27	0.09	0.00	0.00	0.14
DIK	Dichloran	99309	Fungicide	33.0000	0.43	no data	0.84	0.46	0.38	0.61	no data	0.35
DIM	Dimethoate	60515	Insecticide	2.4000	0.13	0.22	0.50	0.85	0.83	0.98	0.00	0.38
DIN	Dinocap	6119922	Fungicide	0.3173	0.00	no data	no data	0.00	0.47	0.76	0.00	0.36
DIQ	Diquat (form not specified)	2764729	Herbicide	1.1040	0.12	1.00	1.00	0.25	0.00	0.00	0.00	0.03
DME	Dimethomorph	1.10E+08	Fungicide	0.2250	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.06
DOD	Dodine (dodecylguanidine monoacetate)	2439103	Fungicide	2.1125	0.04	0.29	0.88	0.35	0.18	0.01	0.00	0.08
DPA	Diphenylamine	122394	Fungicide	2.0480	0.02	no data	0.02	no data	0.07	0.00	0.00	0.08
DPB	2,4-DB (form not specified)	94826	Herbicide	1.7188	0.02	no data	0.19	0.25	0.05	0.00	no data	0.19
DPI	Clopyralid	1702176	Herbicide	0.2003	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.04
DPP	Diclofop-methyl	51338273	Herbicide	0.9940	0.00	0.16	0.00	no data	0.12	0.00	no data	0.18

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
DPY	Rimsulfuron	1.23E+08	Herbicide	0.0150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DUB	Chlorpyrifos	2921882	Insecticide	4.9950	1.00	0.23	0.80	1.00	0.65	0.92	0.00	0.61
DUR	Diuron	330541	Herbicide	5.4000	0.06	1.00	0.63	0.32	0.23	0.23	0.06	0.23
DXA	2,4-D (acid)		Herbicide	2.7260	0.04	0.00	0.72	0.37	0.23	0.21	0.00	0.11
DXB	2,4-D (unspecified amine salt)	94757	Herbicide	2.7600	0.16	no data	no data	no data	0.07	0.00	no data	0.06
DXF	2,4-D (unspecified ester)	25168267	Herbicide	3.1350	0.10	no data	0.63	0.30	0.24	0.25	0.00	0.32
DYR	Anilazine	101053	Fungicide	3.3750	0.02	no data	0.03	0.30	0.34	0.54	no data	0.35
EFR	Ethalfluralin	55283686	Herbicide	1.4000	0.01	0.00	0.00	0.29	0.23	0.21	0.00	0.30
ENT	Endothall (form not specified)	145733	Herbicide	1.3640	0.11	0.24	0.98	no data	0.10	0.00	0.00	0.10
EPT	EPTC	759944	Herbicide	6.8000	0.36	no data	0.20	0.56	0.22	0.17	0.00	0.12
ESF	Endosulfan	115297	Insecticide	4.5000	0.50	0.19	0.96	0.55	0.56	0.86	0.00	0.96
ETF	Ethephon	16672870	Growth Regulator	3.3600	0.02	no data	0.00	0.40	0.00	0.00	0.00	0.06

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
ETM	Ethametsulfuron (form not specified)	97780068	Herbicide	0.0225	0.00	no data	0.00	0.05	0.00	0.00	0.00	0.00
ETS	Ethofumesate	67293747	Herbicide	3.9600	0.02	0.00	1.00	0.37	no data	no data	no data	0.32
FAA	N-Decanol	112301	Growth Regulator	14.4400	0.07	no data	0.00	no data	0.30	0.43	no data	0.32
FAB	N-Octanol	111875	Herbicide	16.0820	0.07	no data	no data	no data	0.08	0.00	0.00	0.10
FAD	Famoxadone	1.32E+08	Fungicide	0.2100	0.00	0.12	0.00	0.13	0.32	0.49	0.00	0.29
FAL	Fosetyl-al	39148248	Fungicide	4.4800	0.01	no data	0.00	0.30	0.00	0.00	0.00	0.00
FBZ	Fenbuconazole	1.20E+08	Fungicide	0.1050	0.00	0.00	no data	no data	0.00	0.00	no data	0.06
FED	Fenamidone	1.61E+08	Fungicide	0.1000	0.00	0.00	0.00	0.03	0.06	0.00	0.00	0.08
FER	Ferbam	14484641	Fungicide	6.2700	0.07	no data	0.04	0.55	0.57	0.88	0.00	0.53
FEX	Fenhexamid	1.27E+08	Fungicide	0.8500	0.01	0.00	0.00	0.15	0.05	0.00	0.00	0.18
FLD	Fludioxonil	1.31E+08	Fungicide	0.0019	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FLM	Flumetsulam	98967409	Herbicide	0.0707	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
FLR	Fluroxypyr 1-methylheptyl ester		Herbicide	0.1440	0.00	0.00	0.00	0.09	0.20	0.13	0.00	0.22
FLS	Flucarbazone-sodium		Herbicide	0.0284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
FLT	Flufenacet	1.42E+08	Herbicide	0.7997	0.01	0.13	0.00	0.22	0.08	0.00	0.47	0.19
FLZ	Fluazinam	79622596	Fungicide	0.1600	0.00	0.00	0.00	0.10	0.18	0.01	0.00	0.22
FMS	Foramsulfuron	1.73E+08	Herbicide	0.0300	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.02
FOF	Fomesafen	72178020	Herbicide	0.2400	0.00	0.17	0.00	0.08	0.00	0.00	0.00	0.02
FOL	Folpet		Fungicide	5.0000	0.05	0.00	0.00	0.41	0.40	0.65	0.00	0.38
FOM	Formetanate (form not specified)	23422539	Insecticide	4.1216	0.62	1.00	1.00	0.00	0.39	0.63	0.00	0.22
FOR	Formaldehyde	50000	Fungicide	1.1877	0.03	no data	0.33	no data	0.00	0.00	no data	0.08
FPF	Fenoxaprop-p-ethyl	71283802	Herbicide	0.1006	0.00	no data	0.00	0.00	0.00	0.00	0.00	0.06
FRA	Florasulam	1.46E+08	Herbicide	0.0050	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FZA	Fluazifop-p-butyl	79241466	Herbicide	0.2500	0.00	no data	0.00	0.07	0.00	0.00	0.00	0.06

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
GLG	Glufosinate ammonium	77182822	Herbicide	1.0005	0.01	0.04	0.04	0.15	0.00	0.00	0.00	0.03
GOO	Azinphos-methyl	86500	Insecticide	2.2200	0.89	0.15	0.80	0.74	0.61	0.90	no data	0.83
GPI	Glyphosate (isopropylamine salt)	38641940	Herbicide	4.3200	0.04	0.14	0.00	0.33	0.00	0.00	0.00	0.10
GPM	Glyphosate (mono-ammonium salt)		Herbicide	4.3500	0.05	no data	no data	no data	0.00	0.00	no data	0.05
GPP	Glyphosate (potassium salt)	70901121	Herbicide	4.3200	0.06	no data	no data	no data	0.00	0.00	no data	0.08
GPS	Glyphosate (acid)	1071836	Herbicide	4.9500	0.05	no data	0.00	0.34	0.00	0.00	0.00	0.06
GPT	Glyphosate (trimethylsulfonium salt)	81591813	Herbicide	3.9700	0.06	no data	no data	0.26	0.00	0.00	0.00	0.09
HEC	Hexaconazole	79983714	Fungicide	0.0019	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IDO	Iodosulfuron-methyl-sodium	1.45E+08	Herbicide	0.0020	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IMI	Imidacloprid	1.38E+08	Insecticide	0.3120	0.08	0.07	0.00	0.82	0.40	0.66	0.00	0.06
IMP	Imazethapyr	81335775	Herbicide	0.9515	0.01	no data	0.00	0.10	0.00	0.00	0.00	0.06

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
IMZ	Imazamox	1.14E+08	Herbicide	0.0252	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IPD	Iprodione	36734197	Fungicide	1.5000	0.02	0.10	0.00	0.15	0.25	0.29	0.00	0.11
IXF	Isoxaflutole	1.41E+08	Herbicide	0.1056	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.06
KRB	Propyzamide	23950585	Herbicide	2.2500	0.01	0.25	0.00	0.22	0.16	0.00	0.00	0.23
KRS	Kresoxim-methyl	1.43E+08	Fungicide	0.2250	0.00	0.00	0.00	0.20	0.14	0.00	0.00	0.14
LUN	Linuron	330552	Herbicide	4.5000	0.13	0.83	0.97	0.21	0.35	0.55	0.05	0.23
MAA	MCPA (acid)	94746	Herbicide	1.7500	0.09	0.00	0.50	0.31	0.00	0.00	0.00	0.19
MAB	MCPA (dimethylammine salt)	94746	Herbicide	2.3750	0.09	no data	0.66	0.40	0.00	0.00	0.00	0.09
MAE	MCPA (unspecified ester)	94746	Herbicide	1.7500	0.01	no data	no data	0.38	0.33	0.51	0.00	0.19
MAH	Maleic hydrazide (form not specified)	123331	Growth Regulator	3.3900	0.03	no data	0.00	0.36	0.00	0.00	0.00	0.08
MAL	Malathion	121755	Insecticide	3.7500	0.06	0.05	0.10	0.78	0.38	0.62	no data	0.22
MAN	Maneb	12427382	Fungicide	2.6000	0.02	0.14	0.00	0.47	0.25	0.29	0.00	0.30

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
MAS	MCPA (potassium salt)	3653483	Herbicide	2.7000	0.13	no data	no data	no data	0.00	0.00	0.00	0.10
MBS	MCPB (sodium salt)	6062266	Herbicide	1.7000	0.10	no data	0.46	0.37	0.00	0.00	0.00	0.11
MCZ	Mancozeb	8018017	Fungicide	7.2000	0.02	0.59	0.00	0.43	0.45	0.72	0.00	0.22
MEA	Mecoprop (potassium salt)	1929868	Herbicide	1.1550	0.03	no data	no data	no data	0.00	0.00	no data	0.06
MEC	Mecoprop (form not specified)	1929868	Herbicide	0.8500	0.02	no data	no data	0.31	0.00	0.00	no data	0.06
MEI	Dimethenamid	87674688	Herbicide	1.6830	0.02	0.03	0.00	0.15	0.12	0.00	0.00	0.22
MEM	Metsulfuron-methyl	74223646	Herbicide	0.0900	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.03
MER	Mesotrione	1.04E+08	Herbicide	0.1440	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03
MET	Methoxychlor	72435	Insecticide	2.7000					0.37	0.61	no data	0.30
MEW	Mecoprop d-isomer (potassium salt)		Herbicide	1.0500	0.03	no data	no data	no data	0.00	0.00	no data	0.06
MEX	Tribenuron methyl	1.01E+08	Herbicide	0.1875	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
MEZ	Mecoprop d-isomer (amine salt)		Herbicide	0.8500	0.03	no data	no data	no data	0.00	0.00	no data	0.06

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
MFN	Metalaxyl-m (mefenoxam)	70630170	Fungicide	1.1110	0.02	no data	0.05	0.33	0.00	0.00	0.00	0.06
MML	Methomyl	16752775	Insecticide	1.9350	0.00	0.02	0.12	0.70	0.37	0.60	0.00	0.23
MMM	Thifensulfuron-methyl	79277273	Herbicide	1.2375	0.01	0.00	0.00	0.34	0.00	0.00	0.00	0.06
MOM	Methamidophos	10265926	Insecticide	1.1040	1.00	0.24	0.94	0.67	0.73	0.95	0.00	0.06
MOR	Chinomethionat	2439012	Fungicide	0.5000	0.01	0.48	0.00	0.18	0.37	0.60	0.00	0.29
MPR	(S)-Methoprene	40596698	Insecticide	0.2380	0.00	0.13	0.00	0.00	0.00	0.00	no data	0.03
MTA	Metalaxyl	57837191	Fungicide	0.0479					0.00	0.00	0.00	0.03
MTL	Metolachlor	51218452	Herbicide	2.1480	0.02	0.38	0.00	0.26	0.13	0.00	0.00	0.18
MTR	Metiram	9006422	Fungicide	4.8000	0.04	0.34	0.00	0.36	0.03	0.00	0.00	0.08
MXF	Methoxyfenozide	1.61E+08	Insecticide	0.2400	0.00	0.00	0.00	0.08	0.14	0.00	0.00	0.12
MYC	Myclobutanil	88671890	Fungicide	0.1360	0.01	0.12	0.00	0.00	0.05	0.00	0.00	0.08
NAA	1-Naphthalene actetic acid (form not	86873	Growth Regulator	0.0000	0.00	no data	0.00	no data	0.00	0.00	no data	0.00

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
	specified)											
NAD	Naphthaleneacetamide	86862	Growth Regulator	0.1668	0.00	no data	0.00	no data	no data	no data	no data	no data
NAL	Naled	300765	Insecticide	1.9008	0.96	0.15	0.84	0.72	0.57	0.87	0.00	0.35
NAP	Naptalam (form not specified)	132661	Herbicide	7.2000	0.03	no data	0.86	0.37	0.00	0.00	no data	0.10
NBP	Napropamide	15299997	Herbicide	6.7000	0.16	0.42	0.00	0.35	0.14	0.00	no data	0.22
NIO	Nicosulfuron	1.12E+08	Herbicide	0.0251	0.00	no data	0.00	0.00	0.00	0.00	0.00	0.00
NXI	Acetamiprid	1.35E+08	Insecticide	0.1680	0.02	0.00	0.00	0.27	0.13	0.00	0.00	0.05
OXB	Oxamyl	23135220	Insecticide	2.2440	0.85	0.22	0.98	0.62	0.43	0.70	0.00	0.19
OXR	Oxyfluorfen	42874033	Herbicide	0.4960	0.00	0.31	0.00	0.14	0.00	0.00	0.00	0.18
PAQ	Paraquat (form not specified)	4685147	Herbicide	1.5000	0.07	no data	1.00	0.36	0.00	0.00	0.06	0.03
PEN	Pendimethalin	40487421	Herbicide	1.0880	0.02	0.26	0.00	0.40	0.08	0.00	0.00	0.12
PFL	Permethrin	52645531	Insecticide	2.5000	0.00	0.55	0.29	0.94	0.62	0.91	0.00	0.36

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
PFN	Picolinafen	1.38E+08	Herbicide	0.0503	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
PHR	Phorate		Insecticide						0.88	0.98	0.00	0.98
PHS	Phosalone	2310170	Insecticide	0.6250	0.01	no data	0.77	0.34	0.43	0.69	no data	0.22
PHY	Propamocarb hydrochloride		Fungicide	1.0125	0.01	0.00	0.00	0.26	0.00	0.00	0.00	0.05
PIC	Picloram (form not specified)	1918021	Herbicide	2.1600	0.02	no data	0.00	0.31	0.20	0.10	0.00	0.19
PID	Picloram (triisopropanolamine salt)	1918021	Herbicide	0.0240	0.00	no data	0.00	0.00	0.00	0.00	0.00	0.02
PIR	Pirimicarb	23103982	Insecticide	0.8500	0.00	0.03	0.89	0.29	0.30	0.44	0.00	0.08
PMP	Phenmedipham	13684634	Herbicide	0.7125	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.06
PON	Propiconazole	60207901	Fungicide	0.1900	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.06
PRI	Primisulfuron-methyl	86209510	Herbicide	0.0300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
PRO	Prometryne	7287196	Herbicide	3.4000	0.02	0.31	0.41	0.30	0.31	0.47	0.13	0.22
PRT	Phosmet	732116	Insecticide	1.8750	0.76	0.22	0.80	0.62	0.49	0.79	0.00	0.35

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
PSF	Prosulfuron	94125345	Herbicide	0.0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PYA	Pyraclostrobin	1.75E+08	Fungicide	0.2250	0.00	0.00	0.00	0.07	0.29	0.42	0.00	0.29
PYD	Pyridaben	96489713	Insecticide	0.5400	0.00	0.00	0.00	0.90	0.52	0.82	0.00	0.35
PYR	Pyrethrins	121211	Insecticide	0.0100	0.00	no data	0.00	0.44	0.00	0.00	no data	0.06
PYZ	Pyrazon (chloridazon)	1698608	Herbicide	4.4075	0.03	no data	0.21	0.28	0.00	0.00	0.00	0.12
PZN	Pymetrozine	1.23E+08	Insecticide	0.0965	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
QPE	Quizalofop p-ethyl	1.01E+08	Herbicide	0.0720	0.00	no data	0.00	no data	0.00	0.00	no data	0.06
QTZ	Quintozene	82688	Fungicide	1.6875	0.01	0.00	0.00	0.25	0.27	0.35	no data	0.22
QUC	Quinclorac	84087014	Herbicide	0.1238	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
SLF	Sulfosulfuron	1.42E+08	Herbicide	0.0203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
SMZ	Simazine	122349	Herbicide	5.4000	0.01	0.36	0.01	0.35	0.12	0.00	0.00	0.22
SOD	Sethoxydim	74051802	Herbicide	0.4950	0.00	0.03	0.00	0.34	0.00	0.00	0.00	0.11

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
SPI	Spinosad	1.32E+08	Insecticide	0.1056	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.03
SUL	Sulphur	7704349	Fungicide	18.0000	0.07	no data	0.98	0.25	0.00	0.00	no data	0.06
TCM	2-(Thiocyanomethylthio)benzothiazole	21564170	Fungicide	0.0736	0.00	no data	no data	no data	0.18	0.02	no data	0.22
TEL	Tefluthrin	79538322	Insecticide	7.3500					0.87	0.98	no data	1.00
TER	Terbacil	5902512	Herbicide	3.6000	0.03	0.00	0.74	0.26	0.04	0.00	0.19	0.11
TET	Chlorothalonil	1897456	Fungicide	5.8000	0.04	0.32	0.00	0.31	0.57	0.87	0.00	0.55
TEU	Tebuconazole	80443410	Fungicide	0.1261	0.00	0.00	0.00	0.22	0.02	0.00	0.00	0.04
TFS	Triflusulfuron methyl	1.27E+08	Herbicide	0.0350	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
TFY	Trifloxystrobin	1.42E+08	Fungicide	0.1225	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.19
TFZ	Tebufenozide	1.12E+08	Insecticide	0.2880	0.00	0.00	0.00	0.02	0.17	0.00	0.00	0.19
THE	Thiamethoxam	1.54E+08	Insecticide	0.0286					0.00	0.00	0.00	0.02
THI	Thiram	137268	Fungicide	30.0000	0.63	0.71	0.99	0.53	0.63	0.91	0.00	0.96

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
TLL	Triadimenol	55219653	Fungicide	0.0380					0.00	0.00	0.00	0.00
TPA	Tepraloxydim	1.50E+08	Herbicide	0.0500	0.00	0.00	0.00	0.00	0.00	0.00	no data	0.02
TPM	Thiophanate-methyl	23564058	Fungicide	1.5750	0.01	0.18	0.00	0.24	0.18	0.01	0.00	0.10
TPR	Triclopyr	55335063	Herbicide	3.8400	0.05	0.49	0.95	0.32	0.02	0.00	0.00	0.29
TRA	Tralkoxydim	87820880	Herbicide	0.2000	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.06
TRF	Trifluralin	1582098	Herbicide	2.0160	0.02	0.27	0.00	0.33	0.19	0.05	0.00	0.29
TRI	Trichlorfon	52686	Insecticide	3.2000	0.34	0.21	0.56	0.35	0.70	0.94	0.00	0.30
TRL	Triallate	2303175	Herbicide	2.2080	0.02	0.44	0.18	0.40	0.32	0.48	0.00	0.19
TRR	Triforine		Fungicide	0.5850	0.00	0.05	0.00	0.16	0.00	0.00	0.00	0.06
TRS	Triasulfuron	82097505	Herbicide	0.0248	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRT	Triticonazole	1.32E+08	Fungicide	0.0060	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
TZL	Thiabendazole	148798	Fungicide	1.0000	0.01	1.00	0.00	no data	0.25	0.31	0.00	0.10
VIL	Vinclozolin	50471448	Fungicide	1.0000	0.01	0.16	0.00	0.20	0.15	0.00	0.00	0.11

Table 20: Amalgamated risk scores for all pesticide liquid applications at maximum label rate. All areas shaded in grey represent a pesticide used as particulate only (seed treatment or granular application).

AI Code	AI Accepted Name	CAS	Type	Maximum Application Rate (kg ai/ha)	Acute Avian Score	Chronic Avian Score	Acute Small Mammal Score	Bee Risk Score	Crustacea Diversity Count Ratio	Most Conservative of Cladocera & Copepoda Models	Algae Count Ratio	Fish Risk score
VIT	Carbathiin	5234684	Fungicide	0.0761					0.00	0.00	0.00	0.08
VPR	Hexazinone	51235042	Herbicide	2.0250	0.02	1.00	0.75	0.27	0.00	0.00	0.19	0.06
ZIN	Zineb	12122677	Fungicide	2.6400	0.03	no data	0.00	0.76	0.20	0.12	0.00	0.19
ZIR	Ziram	137304	Fungicide	6.8000	0.33	no data	0.93	0.41	0.49	0.78	0.00	0.55
ZOX	Zoxamide	1.56E+08	Fungicide	0.2240	0.00	0.00	0.00	0.07	0.17	0.00	0.00	0.11

17 AMALGAMATED RISK SCORES FOR ALL PESTICIDE SEED TREATMENT APPLICATIONS AT MAXIMUM LABEL RATE.

Table 21: Amalgamated risk scores for all pesticide seed treatment applications at maximum label rate.

AI Code	AI Accepted Name	Type of seed treated	Acute Avian Relative risk corrected for seed attractiveness	Chronic Avian Relative risk score corrected for seed attractiveness	Acute Mammal Relative risk
CAP	Captan	Corn	1.00	1.00	0.04
COD	Clothianidin	Canola	0.00	0.03	0.00
COD	Clothianidin	Corn	0.58	1.00	0.02
DFZ	Difenoconazole	Canola	0.00	0.00	0.00
DFZ	Difenoconazole	Cereal	0.01	0.64	0.00
DFZ	Difenoconazole	Corn	0.02	1.00	0.01
DIA	Diazinon	Corn	1.00	1.00	0.11
FLD	Fludioxonil	Canola	0.00	0.00	0.00
FLD	Fludioxonil	Cereal	0.00	0.06	0.00
FLD	Fludioxonil	Corn	0.00	0.20	0.00
IMI	Imidacloprid	Canola	0.04	1.00	0.01
IMI	Imidacloprid	Corn	1.00	1.00	0.58
IPD	Iprodione	Canola	0.00	0.03	0.00
MAN	Maneb	Cereal	0.03	1.00	0.00
MCZ	Mancozeb	Corn	0.04	1.00	0.02
MFN	Metalaxyl-m (mefenoxam)	Canola	0.00	no data	0.00
MFN	Metalaxyl-m (mefenoxam)	Cereal	0.00	no data	0.00

Table 21: Amalgamated risk scores for all pesticide seed treatment applications at maximum label rate.

AI Code	AI Accepted Name	Type of seed treated	Acute Avian Relative risk corrected for seed attractiveness	Chronic Avian Relative risk score corrected for seed attractiveness	Acute Mammal Relative risk
MFN	Metalaxyl-m (mefenoxam)	Corn	0.02	no data	0.01
MTA	Metalaxyl	Canola	0.00	0.01	0.00
MTA	Metalaxyl	Cereal	0.02	0.71	0.00
MTA	Metalaxyl	Corn	0.36	1.00	0.10
NXI	Acetamiprid	Canola	0.00	0.07	0.01
TEU	Tebuconazole	Cereal	0.02	1.00	0.01
THE	Thiamethoxam	Canola	0.00	0.02	0.00
THE	Thiamethoxam	Cereal	0.02	0.21	0.00
THE	Thiamethoxam	Corn	0.16	1.00	0.04
THI	Thiram	Canola	0.01	1.00	0.01
THI	Thiram	Cereal	0.09	1.00	0.01
THI	Thiram	Corn	0.75	1.00	0.19
TLL	Triadimenol	Cereal	0.00	1.00	0.00
TPM	Thiophanate-methyl	Corn	0.02	1.00	0.01
TRT	Triticonazole	Cereal	0.00	0.12	0.00
VIT	Carbathiin	Canola	0.00	0.03	0.00
VIT	Carbathiin	Cereal	1.00	1.00	0.01
VIT	Carbathiin	Corn	1.00	1.00	0.02

18 AMALGAMATED RISK SCORES FOR ALL PESTICIDE GRANULAR APPLICATIONS AT MAXIMUM LABEL RATE.

Table 22: Amalgamated risk scores for all granular pesticide applcations at maximum label rate.

AI Code	Pesticide	% guarantee	Acute Avian Relative risk	Chronic Avian Relative risk unadjusted for differential granule base	Acute Mammal Relative risk
CAB	Carbaryl	5.00%	0.02	0.05	0.00
COY	Terbufos	15.00%	1.00	1.00	1.00
DAZ	Dazomet	97.00%	0.24	1.00	0.06
DIA	Diazinon	5.00%	1.00	1.00	0.01
DUB	Chlorpyrifos	15.00%	0.53	1.00	0.02
EFR	Ethalfluralin	5.00%	0.00	0.05	0.00
EPT	EPTC	5.00%	0.03	no data	0.00
EPT	EPTC	10.00%	0.05	no data	0.00
EPT	EPTC	25.00%	0.13	no data	0.00
MFN	Metalaxyl-m (mefenoxam)	1.00%	0.00	no data	0.00
MTA	Metalaxyl	1.00%	0.00	0.05	0.00
MTA	Metalaxyl	2.00%	0.00	0.11	0.00
NBP	Napropamide	10.00%	0.02	0.12	0.00
PHR	Phorate	15.00%	1.00	1.00	1.00
TEL	Tefluthrin	3.00%	0.00	1.00	0.03
TRF	Trifluralin	3.00%	0.00	1.00	0.00
TRF	Trifluralin	4.00%	0.00	1.00	0.00

Table 22: Amalgamated risk scores for all granular pesticide applcations at maximum label rate.

AI Code	Pesticide	% guarantee	Acute Avian Relative risk	Chronic Avian Relative risk unadjusted for differential granule base	Acute Mammal Relative risk
TRF	Trifluralin	5.00%	0.00	1.00	0.00
TRF	Trifluralin	10.00%	0.01	1.00	0.00
TRL	Triallate	10.00%	0.01	0.39	0.00

19 PROOF OF CONCEPT – APPLYING RISK MODELS TO PESTICIDE USE INFORMATION

Canada does not collect comprehensive nation-wide pesticide use statistics from farmers. However, as part of the Agricultural Policy Framework of Agriculture and Agri-Food Canada, the Pesticide Risk Reduction group of that Department funded a crop protection survey carried out by Statistics Canada for the 2005 growing season on three different crops: apples, grapes, and carrots. The purpose of the survey was to obtain information on all pest-control practices including chemicals used. A good sample of farms, representative of the entire country, was examined. Among several questions on Integrated Pest Management (IPM) practices, the survey data included application rate, date, product used, predominant pest/disease, and variety of carrot, apple or grape grown. For demonstration purposes, we opted to use the carrot survey as an indication of how pesticide use data could be transformed into environmental impact scores with an eye to determining whether applications would meet the proposed NAESI environmental standards. For the purpose of this document, we provide the results for the acute avian, chronic avian, small mammal population response, and all aquatic indices.

In theory, when pesticide use data become available, they can be run through our models to

determine what practises and general areas cause problems for birds, small mammals, earthworms, bees, or aquatic organisms. This concept can be expanded beyond the survey data for single crops. With adequate pesticide use information, the use of compounds in entire agricultural regions can be assessed rapidly based on how many farmers meet or exceed risk standards. This offers the possibility of deriving area-wide standards for some classes of organisms in line with ecological patch theory and the principle of conservation reservoirs; e.g., no more than x % of a landscape or ecozone should be below standard for pollinator species etc.

19.1 Summary of the data

The carrot survey database included 1062 entries (represented as actual spray events) from farms in NL, PE, NS, NB, QC, ON, and BC. There were 115 farms within the survey. Of the 1062 spray events reported in the database, 53 did not record an application rate. Subsequently, after attempting to fill in the blanks, four entries were still without a rate. For the proof of concept, we were only able to rank the following number (Table 23) of spray events due to a lack of data for certain compounds.

Table 23: Number of actual spray events that were used to test each indicator.

Risk Indicator	Number of spray events run
Acute Avian (Liquid Applications)	1037
Chronic Avian (Liquid Applications)	973
Acute Mammal (Liquid Applications)	1035
All Aquatics (Liquid Applications)	1025

In the carrot survey database, 26% of applications were insecticides, 41% were fungicides, and 33% were herbicides.

We decided to rank the pesticide events on a per-use basis, and also a per-farm basis, as a proof of concept for our risk models (both terrestrial and aquatic). The decision to choose a per-use or per application basis was to determine if the individual application events posed a specific risk to any of the species, which we have modeled for. On the "per-farm" basis, this was an important exercise to determine whether specific farms were causing more environmental impacts than others. For the per-use basis, each application was ranked separately through our risk indices. For the per-farm basis, multiple uses were aggregated as proposed in Mineau *et al.* (2008):

$$= 1 - [\prod_{k=1}^{n} (1 - Pk)]$$

Where:

P is the risk score (probability from 0 to 1), and

n is the total number of applications on the field.

As several of the terrestrial risk indices could use the application rate as their primary input variable, calculating the resulting probability of impact was straightforward. The impact calculations were performed as described in Mineau *et al.* (2008) in a spreadsheet. The aquatic risk calculations required a water concentration estimate. In order to generate concentration values, the application rates were run through the GENEEC 2.0 model with the appropriate application method. The resulting concentrations were then adjusted to fit Manitoba conditions as described in Mineau *et al.* (2008) (see Section 7). These were, in turn, converted to model pond concentrations mentioned in the same section and appropriate risk scores were calculated.

Ideally, different farming areas should have separate adjustment factors reflecting soil type and pluviosity so that pesticide use could reflect the true regional disparities in the likelihood of

aquatic contamination from runoff.

19.2 Manipulation of the database

The database was standardized using product specific guarantee information provided by the PMRA. All application rates were converted from their respective units to grams of active ingredient per hectare (g a.i./ha).

19.3 Filling in the blanks

To have as complete a dataset as possible, we attempted to fill as many blank (unknown) application rates as possible. The main technique used for doing this was a nearest neighbour analysis using a geographic information systems (GIS) interface. The assumption here is that the nearest neighbour using the same product close to the same application date would be experiencing the same pests/disease pressures.

In some cases, a nearest neighbour analysis was not possible; therefore, application rates were taken from the provincial crop recommendations (available from any Provincial Department of Agriculture) or the product label, matching the appropriate time of season.

19.4 Results

Results from the carrot survey data are provided in histogram form (Figures 1 and 2). Details of specific rates, application dates and farms are withheld for reasons of data confidentiality. Seed treatments were omitted from the actual survey and while there were granular pesticides reported, they were all dissolved in water prior to application.

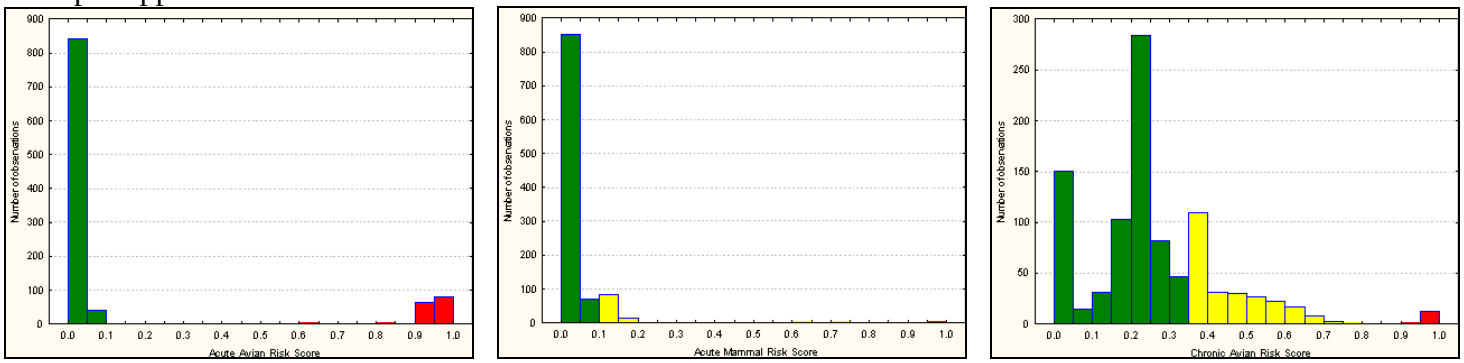
For the purpose of GENEEC runs, no soil incorporation was assumed for any of the products, since none of the products that were listed as being applied pre-seeding were listed as being incorporated on the product label.

19.5 Terrestrial Results

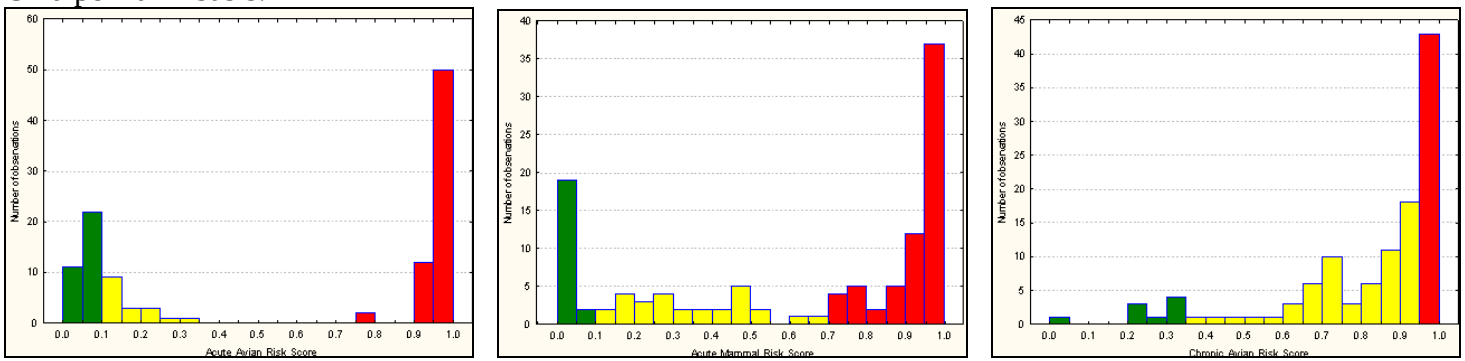
On a “per-application” basis, most applications fell within the acceptable standard for all three terrestrial risk scores. This is not surprising in view of the high proportion of herbicide and fungicide applications, compounds generally considered to be of lower acute toxicity to vertebrates. The chronic avian risk score showed the highest number of applications that were below standard. However, the aggregated scores paint a different picture: It can be seen from the histogram (Figure 1) that few farms are meeting our proposed standard once all applications have been scored and the risk scores multiplied. Indeed, the majority of farms would fall in the high-risk (red-listed) category, mainly because of the large number of separate applications. Farms that remained within the proposed standards tended to be the ones reporting one or two applications throughout the entire growing season. (Independent checking of a select number of survey questionnaires ascertained that these growers truly used fewer sprays and this was not a reporting issue – Tim MacDonald, AAFC, pers. comm.). Such wide variation in the scoring of individual farms opens the way to further consideration of pesticide use on this commodity to ascertain whether the superior rating on some farms can be emulated elsewhere.

Figure 1: Histograms from the three different terrestrial risk indicators for both "per-farm" basis and "per-application" basis. These are colour coded using the traffic-light system described earlier in the document, where all "green" bars represent uses or farms that fall within the proposed standards.

On a per-application basis:



On a per-farm basis:



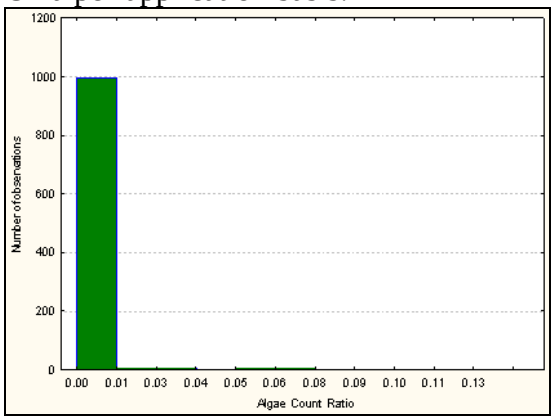
19.6 Aquatic Results

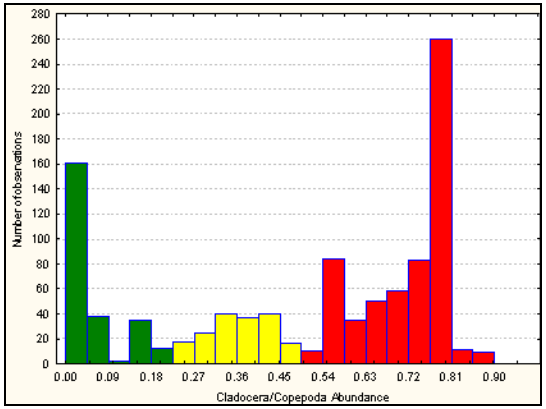
Examining the aquatic histograms on the "per application" basis (Figure 2) shows that all applications fell within standard for the algal model. This is hardly surprising because we found that most pesticides (all but flufenacet), even when applied at maximum label rate could meet the algal standard. The cladocera/copepod abundance was the most sensitive standard most likely to be exceeded.

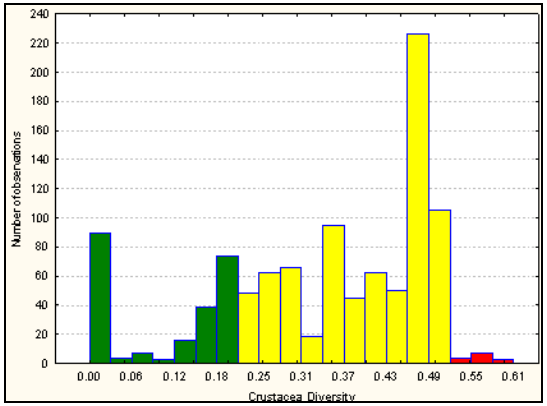
When the scores were aggregated on a "per farm" level over the entire growing season, the majority of farms exceeded the standard for both crustacea species diversity, and cladocera and copepoda abundance. Although we used a pond scenario modeled on PRZM runs for Manitoba field conditions, the high rainfall value that was used does influence how the various scores are aggregated. Indeed, it would be very unlikely for such rainfall conditions to follow every pesticide application as is implicit in the aggregation of risk scores. This suggests that, where the goal is to assess the cumulated risk of an entire season's pesticide input, there would be grounds to modify the procedures so as to model a more average amount of runoff. Alternatively, farm-level water concentrations of various pesticides could be used as a means to correct the GENEEC estimates. This should be a priority for further work.

Figure 2: Histograms from the three different aquatic risk indicators for both "per-farm" basis and "per-application" basis. These are colour coded using the traffic-light system described earlier in the document, where all "green" bars represent uses or farms that fall within standard.

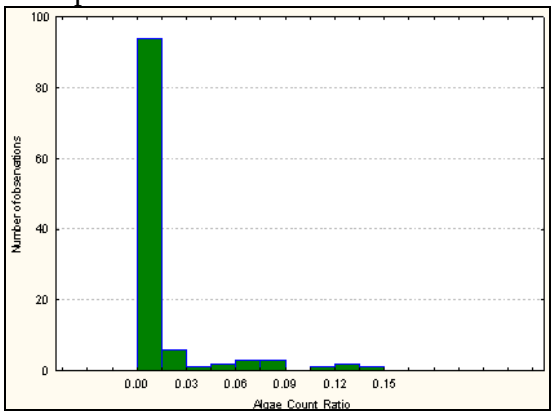
On a per-application basis:

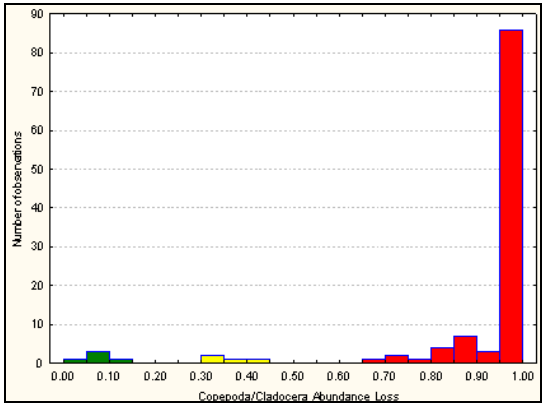


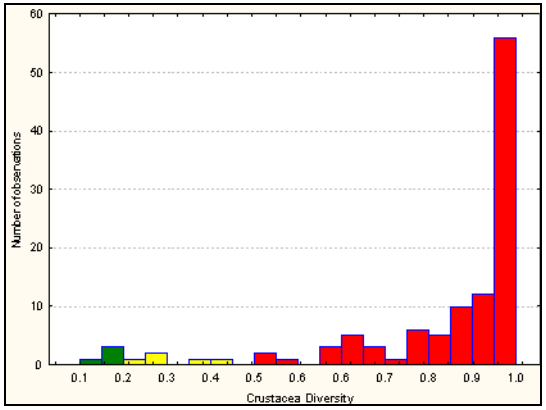




On a per farm basis:







20 REFERENCES

European Commission. 2002. Guidance document on terrestrial ecotoxicology. DRAFT – Working Document 91/414/EEC. Report Number: SANCO/10329/2002 rev 2 final. – Health & Consumer Protection Directorate-General. 39 p.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA nomogram, an instrument for estimating pesticide residues on plants. Environmental Toxicology and Chemistry. 13: 1383–1391.

Harding, K., P. Mineau, M. Whiteside, M.R. Fletcher, and D. Garthwaite. 2006. Developing risk-based rankings for pesticides in support of standard development at environment Canada: Using reports of bee mortality to calibrate laboratory-derived risk indices: an analysis and modeling of 21 years of bee incidents in the UK. National Agri-Environmental Standards Initiative Technical Series Report No. 2-44. 89 p.

Hoerger, F.D. and E.E. Kenaga. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. In: F. Coulston and F. Korte (eds.). Environmental Quality, Vol. 1. Academic, New York, NY. pp. 9–28.

Mineau, P. 2005. A review and analysis of study endpoints relevant to the assessment of 'long term' pesticide toxicity in avian and mammalian wildlife. Ecotoxicology. 14(8): 775-799.

Mineau, P., A. Baril, B.T. Collins , J. Duffe, G. Joerman, and R. Luttik. 2001. Reference values for comparing the acute toxicity of pesticides to birds. Reviews of Environmental Contamination and Toxicology. 170:13-74.

Mineau, P., T. Dawson, M. Whiteside, C. Morrison, K. Harding, L. Singh, T. Längle, and D.A.R. McQueen. 2008. Environmental Risk-Based Standards for Pesticide Use in Canada. National Agri-Environmental Standards Initiative Synthesis Report. Environment Canada. Gatineau, QC. 98 p. Draft.

Richards, N.L., P. Mineau, and D.M. Bird. 2004. Exposure of the eastern screech-owl (*Otus asio*) to organophosphorus insecticides and anticoagulant rodenticides in apple orchards of

southern Quebec, Canada. In: R.D. Chancellor and B.-U. Meyburg (eds.). Raptors Worldwide. World Working Group on Birds of Prey. pp. 389-408.

Whiteside, M., P. Mineau, C. Morrison, and K. Harding. 2006. Developing Risk-Based Rankings for Pesticides in Support of Standard Development at Environment Canada: Preliminary Terrestrial Rankings. National Agri-Environmental Standards Initiative Technical Series Report No. 2-43. 92 p.