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Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

Chemical Review Committee
Seventeenth meeting
Rome (online), 20–24 September 2021
Item 4 (b) (iii) of the provisional agenda*

Technical work: review of notifications of final regulatory action: iprodione

Iprodione: supporting documentation provided by Mozambique

Note by the Secretariat

As is mentioned in the note by the Secretariat on iprodione: notifications of final regulatory action (UNEP/FAO/RC/CRC.17/5), the annex to the present note sets out documentation provided by Mozambique to support its notification of final regulatory action for iprodione in the pesticide category. The present note, including its annex, has not been formally edited.

* UNEP/FAO/RC/CRC.17/1.

Annex

Iprodione: supporting documentation provided by Mozambique

List of documents:

1. Deliberacao Nr. 001/DNSA/2014 - National Directorate of Agriculture and Agrarian Services (The Pesticide Register Authority) in Portuguese and English.

2. Come A.M. & van der Valk H., 2014. Reducing Risks of Highly Hazardous Pesticides in Mozambique: Step 1 – Shortlisting highly hazardous pesticides Consultancy report undertaken under the Project EP/MOZ/101/UEP.

3. Come A.M.; Dona L.L.; Mancini F. & van der Valk H., 2014. Reducing Risks of Highly Hazardous Pesticides in Mozambique: Step 2 – Survey of pesticide use practices in selected cropping systems.

4. FAO/WHO (2008) Report of the 2nd Joint Meeting on Pesticide Management and the 4th Session of the FAO Panel of Experts on Pesticide Management. 6-8 October 2008, Geneva. Food and Agriculture Organization of the United Nations, Rome & World Health Organization, Geneva. http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Report.pdf (p.14 – 18).

5. Lahr J., R. Kruijne & J. Groenwold, 2014. Hazards of pesticides imported into Mozambique, 2002-2011. Wageningen, Alterra Wageningen UR (University & Research centre).

6. World Health Organization & International Programme on Chemical Safety. (2010). The WHO recommended classification of pesticides by hazard and guidelines to classification 2009. World Health Organization.

7. Pesticides Properties Database (PPDB): https://sitem.herts.ac.uk/aeru/ppdb/en/Reports/403.htm#none (abstract).

8. IPCS-INCHEM International Programme on Chemical Safety – Iprodione (Pesticides residues in food: 1977 evaluations); http://inchem.org/documents/jmpr/jmpmono/v077pr32.htm (abstract).

9. IPCS-INCHEM International Programme on Chemical Safety – Iprodione (addendum to Pesticides residues in food: 1977 evaluations); http://inchem.org/documents/jmpr/jmpmono/v95pr11.htm (abstract).

10. US EPA Reregistration Eligibility Decision (RED) factsheet: https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_PC-109801_1-Nov-98.pdf.

República de Moçambique

MINISTÉRIO DA AGRICULTURA
DIRECÇÃO NACIONAL DE SERVIÇOS AGRÁRIOS

Deliberação Nº 001/DNSA/2014

OS pesticidas são produtos usados para a preservação das culturas e seus produtos contra diferentes pragas. Estes produtos, são por sua natureza tóxica e o uso indevido do mesmo pode perigar a saúde Humana, Animal e danificar o meio ambiente. Deste grupo de químicos, existem alguns que são considerados Altamente Perigoso. O Projecto de Redução dos de Riscos de Pesticidas Altamente Perigosos identificou os Pesticidas Altamente Perigosos que estão registados em Moçambique e depois de auscultar diferentes intervenientes (sector público, sector privado, sociedade civil e outros) conclui-se que para alguns deles dever-se-ia fazer o cancelamento imediato do registo e consequente não aprovação do seu uso em Moçambique e para outros o registo deveria ser cancelado no final do ano. Existe um outro grupo que carece de maior análise antes da tomada de decisão.

Desta forma e usando das competências atribuídas no artigo 3, coadjuvado com o artigo 1 e 4 de Decreto 6/2009 de 31 de Março a DNSA determina:

1. O Cancelamento imediato de todos os pesticidas que contenham as seguintes substâncias activas:

    a. Alachlor
    b. Aldicarb
    c. Carbendazim
    d. Carbofuran
    e. Diafenthiuron
    f. Diazinon (> 300 g/L)
    g. Diclofop–methyl
    h. Difenacoum
    i. Ethion
    j. Fenamiphos
    k. Iprodione
    l. Furfural
    m. Methidathion
    n. Methiocarb
    o. Monocrotophos
    p. Terbufos

DNSA-Rua da Resistência,Nr. 1746, Segundo Andar E-mail- dnsa.minag@gmail.com
Endereço Postal: DNSA, Caixa Postal 2272, Maputo-Moçambique;
Fax: (258)21 415103, Telefone: (258) 21415110

q. Thiodicarb
r. Zinc phosphide
s. Brodifacoum (formulações líquidas – 0.75 & 2.5 g/L)
t. Difethialone
u. Methamidophos
v. Benomyl
w. Methomyl 900 g/kg
x. Chlorfenvinphos
y. Carbaryl
z. Oxyfluorfen

2. Cancelamento à 31 de Dezembro de 2014 de todos os produtos que contenham as substâncias activas:

   a. 2,4-D dimethylamine
   b. Paraquat
   c. Endosulfão
   d. Diuron

3. Os produtos que contenham as substâncias activas listadas nos números 1 e 2 importados antes do cancelamento dos mesmos podem continuar a ser usados estando dentro do prazo de validade.

Maputo aos 15 de Julho de 2014

O Director Nacional

Mahomed Rafik Valá
(Tecnico Superior Agro-Pec de N1)

KC/19/10/2014

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Republic de Mozambique

MINISTRY OF AGRICULTURE

N N. 00I / DNSA / 2014

National Directorate of Agrarian Services

Deliberation N. 00I / DNSA / 2014

Pesticides are products used for the protection of crops and their products against different pests.

These products are by their nature toxic and their improper use can damage human health, animal health and damage the environment. among this group of chemicals, there are some that are considered Highly Hazardous. The project of Risk Reduction of Highly Hazardous Pesticides identified Highly Hazardous Pesticides that are registered in Mozambique and after consulting with different actors (public sector, private sector, civil society and others) it has been concluded that: for some of them the immediate cancellation of registration and consequent non-approval of their use in Mozambique should be done while for others the registration should be cancelled at the end of the year. There is another group for which further analysis is needed before taking the decision

In this way and using the competences assigned by article 3, in conjunction with article I and 4 of Decree 6/2009 of March 31, DNSA determines:

l. The immediate cancellation of all pesticides containing the following active substances:

Alachlor
Aldicarb
Carbendazim
Carbofuran
Diafenthiuron
Diazinon 300 g / L)
Diclofop-methyl
Difenacoum
Ethion
Fenamiphos
Iprodione
Furfural
Methidathion
Methiocarb
Monocrotophos
Terbufos
Thiodicarb
Zinc phosphide
Brodifacoum (liquid formulations -0.75 & 2.5 g/L)
Difethialone
Methamidophos
Benomyl
Methomyl 900 g/kg
Chlorfenvinphos
Carbaryl
Oxyfluorfen

II. Cancellation as of 31 December 2014 of all the products containing the active substances:

2,4-D dimethylamine
Paraquat
Endosulfan
Diuron

III. Products containing the active substances listed in N. 1 and 2 imported before theircancellation can continue to be used as long as they are within the validity period.

Maputo on July 15, 2014

The National Director

Dahomgd Rafikö

Reducing Risks of Highly Hazardous Pesticides in Mozambique

Step 1 – Shortlisting highly hazardous pesticides

Armando Marcos W. Come
Harold van der Valk

[final – 5 May 2014]

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With financial support from the SAICM Quick Start Programme

Acknowledgements

This study was conducted within the framework of Project EP/MOZ/101/UEP – *Reducing Risks of Highly Hazardous Pesticides in Mozambique*. The project is funded by the Quick Start Program of the Strategic Approach to International Chemicals Management (SAICM), the Food and Agriculture Organization of the United Nations and the Government of Mozambique.

The authors would like to gratefully acknowledge the information provided and the contributions made to this study by Ida Chongo and Marcelina Xavier (Ministry of Agriculture), Khalid Cassam and Francesca Mancini (FAO), Kimberly Nesci and Cathleen Barnes (US Environmental Protection Agency),

FAO Disclaimer

Table of contents

1. Introduction

1.1 Project background

Pesticides are widely used in most areas of crop production in Mozambique to minimize infestations by pests and thus protect crops from potential yield losses and reduction of product quality. They are also widely applied for public health purposes, e.g. in malaria control.

The average annual volume of pesticide imports into Mozambique is approximately 1800 tonnes of formulated products (Figure 1). The import value of these pesticides is estimated, over the last three years, to be at least 495 million Meticais, or 16.6 million $US. An almost five-fold increase in pesticide imports has occurred in Mozambique since the 2003, well above world averages.

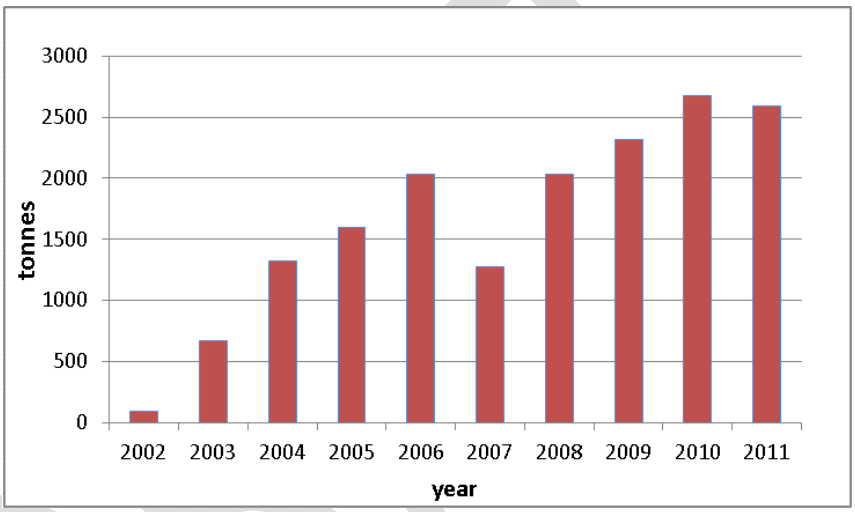

Figure 1. Annual imports of formulated pesticides into Mozambique between 2002 and 2011 (metric tons). Note that the data for 2002 are incomplete. (source: Lahr et al., 2014 based on Ministry of Agriculture statistics)

The large majority of pesticides, about 85%, are imported into Mozambique by private sector distributors and retailers, reflecting major change since the 1980s when pesticides were imported by a single state-run company. The remaining 15% of pesticides are imported directly by commercial farms, by commodity companies, and by various smaller importers. Direct pesticide imports by the state are now virtually non-existent, and state-funded imports are mainly limited to pesticides bought by the Ministry of Health for vector control and by INCAJU for cashew production.

A large part of pesticide distribution to end-users is conducted by private sector distributors and retailers, although exact figures are not available. Furthermore, private distributors deliver the pesticides they import to commodity companies which in turn will distribute the products to end-user farmers. This occurs mostly in cotton and to a smaller extent in tobacco. The private sector may also deliver pesticides to government structures who then distribute them to end-users. This is the case for INCAJU, which distributes pesticides to cashew farmers, and for the Ministry of Health, which distributes a part of the pesticides it orders to community groups to carry out mosquito control. In total, distribution by government structures represented less than 8% of the total pesticides imports.

Pesticide use may have benefits for different stakeholders, not only of farmers or consumers, but also of the society as a whole. At the same time, there is evidence of both direct and indirect risks involved in the use of these chemical substances both for humans and the environment. These risks will vary in importance (i.e. size, duration, extent, acceptability) depending on the type of pesticide and the specific use situation. Risk mitigation measures should be developed for all risks that are considered by the national regulatory authority to be unacceptable. However, given limited human and financial resources in many countries, and also in Mozambique, it may be more cost-effective to focus first on those pesticides and use situations that pose the highest risks and which are considered unacceptable by all relevant stakeholders.

Therefore, with the goal of reducing the greatest risks associated with pesticide use in Mozambique, a project entitled *Reducing Risks of Highly Hazardous Pesticides (HHPs) in Mozambique* was initiated by the Government of Mozambique, with the technical support of FAO's Pesticides Management Unit, and funded by SAICM Quick Start Programme Trust Fund. Its ultimate goal is to develop and implement an "HHP Risk Reduction Action Plan" in Mozambique for the most dangerous pesticides and use situations, resulting over time in the implementation of a variety of risk reduction measures based on a review of use conditions. These could include the cancellation of specific registrations of HHPs, implementation of risk mitigation measures, appropriate use restrictions, development of alternative pest management strategies, promotion of good agricultural practices, and possible phase-out of specific pesticides.

1.2 National and international policy framework

1.2.1 National framework

The major national legislative basis for pesticide distribution use in Mozambique is the Pesticide Management Regulation published under Decree 6/2009 of 31 March 2009 (RepMoz, 2009). The main objective of this Regulation, as laid out in its Article 2.1, is "*to ensure that all processes that involve working with or handling pesticides are executed without prejudice to public, animal and environmental health*". The Regulation further stipulates, in its Article 14, that pesticides will not be approved for use in Mozambique if, among others:

- the pesticide has unacceptable effects on organisms that are intended to be protected;
- the normal and recommended use of the pesticide has the potential to affect negatively human and/or animal health;
- the pesticide causes an unacceptable negative impact on the environment, particularly soil and water contamination, or affects organisms that are not targeted.

This clearly sets the boundaries within which the regulatory authorities in Mozambique can authorize a pesticide for use in the country.

In addition to the Pesticides Management Regulation, environmental, public health and labour legislation further defines the acceptability of risks of chemicals in general, and pesticides in particular, in Mozambique.

1.2.2 International framework

The International Code of Conduct on the Distribution and Use of Pesticides (FAO, 2002) describes the shared responsibility of many sectors of society to work together so that the

benefits to be derived from the necessary and acceptable use of pesticides are achieved without significant adverse effects on human health or the environment.

With respect to the availability and use of pesticides in a country, the Code stipulates in its Article 7, among others, that:

- Responsible authorities should give special attention to drafting rules and regulations on the availability of pesticides. These should be compatible with existing levels of user training and expertise. The parameters on which such decisions on availability are based vary widely and must be left to the discretion of each government.
- Two methods of restricting availability can be exercised by the responsible authority: not registering a product or, as a condition of registration, restricting the availability to certain groups of users in accordance with a national assessment of the hazards involved in the use of the product.
- Prohibition of the importation, sale and purchase of highly toxic and hazardous products, such as those included in WHO classes Ia and Ib, may be desirable if other control measures or good marketing practices are insufficient to ensure that the product can be handled with acceptable risk to the user.

For these reasons, pesticide risk reduction is one of the priority areas of FAO's pesticide management program.

At the request of the Committee on Agriculture (COAG), one of the governing bodies of FAO, the FAO/WHO Joint Meeting on Pesticide Management (JMPM) was asked in 2007 to provide guidance to FAO on the options to define highly hazardous pesticides (HHPs), beyond the definition provided in Article 7 of the Code, as well as on activities that could be initiated to reduce their risks. The JMPM defined on which basis HHPs could be identified (see Chapter 2.1 and FAO/WHO, 2008). The JMPM also recommended, as a general principle, that HHPs should not be registered for use unless:

i. governments establish a clear need;

ii. no alternatives, based on a risk–benefit analysis, are available; and

iii. control measures as well as good marketing practices are sufficient to ensure that the product can be handled with acceptable risk to human health and the environment.

In conjunction with these considerations, the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam, 2009) demonstrates the commitment of FAO and UNEP to address challenges associate with highly hazardous and other pesticide use in Mozambique and other developing countries. Information available on banned or severely restricted pesticides under PIC helps strengthen national decision making on pesticides. The PIC procedure assists countries like Mozambique in avoiding imports of hazardous chemicals that they cannot manage safely under national conditions of use. As such, the Convention helps to prevent incidents before they occur, serving as an early warning system or first line of defence, internationally, that helps keep countries apprised of actions that are being taken by other countries in dealing with problematic chemicals.

These and other efforts, internationally, provide a framework for strengthened pesticide management actions on the ground, in countries such as Mozambique. And in return, as projects such as this one go forward, they contribute to achieving the overall objective of the Strategic Approach to International Chemicals Management (SAICM), which is the sound management of chemicals throughout their life cycle so that, by 2020, chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment.

1.3 The project

1.3.1 Objectives

The main objectives of the project are to:

- Identify pesticides and pesticide use situations which can be considered highly hazardous under Mozambican conditions.
- Elaborate a plan of action to reduce the risks posed by these highly hazardous pesticides.
- Initiate implementation of priority risk reduction activities.
- Review the results of priority risk reduction activities.
- Develop mid- and longer-term policies, programmes and projects to reduce the risk of highly hazardous pesticides.

1.3.2 Approach

The project is organized in five key steps, which are:

- **Step 1** will develop a database of pesticide products presently registered and legally imported to the country in the last 3 years, review Mozambique's registered pesticides against the JMPM criteria for HHPs, identify a list of HHPs being used within the country and development of survey methodology to be used in step 2.
- **Step 2** will conduct field surveys for the identified HHPs, to assess actual use and exposure under local conditions in Mozambique, as well as additional hazard and risk assessments as appropriate.

  On the basis of Steps 1 and 2, HHPs and cropping systems (or use situations) that require risk reduction measures will be identified.
- **Step 3** will develop Risk Reduction Action Plans, with the government and other relevant stakeholders, for HHPs and cropping systems or use situations where risks to human health and/or the environment are likely to be unacceptable.
- **Step 4** will focus on initial implementation of the Action Plans, with the national government, local communities, private/corporate sector, farmers, NGOs/CSOs, academia, scientific and technical community, and other relevant stakeholders carrying out a variety of risk activities both within the scope of this project, as well as in the longer term; and
- **Step 5** will review the Action Plan results achieved, make recommendations going forward, and evaluate the project.

This report specifically covers Step 1 of the project. Its main objective is to provide a short-list of HHPs on which to focus field surveys and hazard/risk assessments in Step 2.

The different activities in Steps 1 and 2 are outlined in Figure 2. They include:

i. Evaluation of all pesticides registered in Mozambique against the JMPM criteria.

ii. Elaboration of a list of HHPs and of pesticides "coming close" to HHPs (see Chapter 2 for more information).

iii. Evaluation of pesticide import statistics for Mozambique to assess which HHPs are presently being used in the country.

iv. Elaboration of a short-list of HHPs which will be further assessed through field surveys and hazard/risk assessments

The ultimate goal of Steps 1 and 2 is to define a list of HHPs, cropping systems and pesticide use situations which would require risk reduction, and for which Risk Reduction Action Plans will be developed under Step 3 of the project.

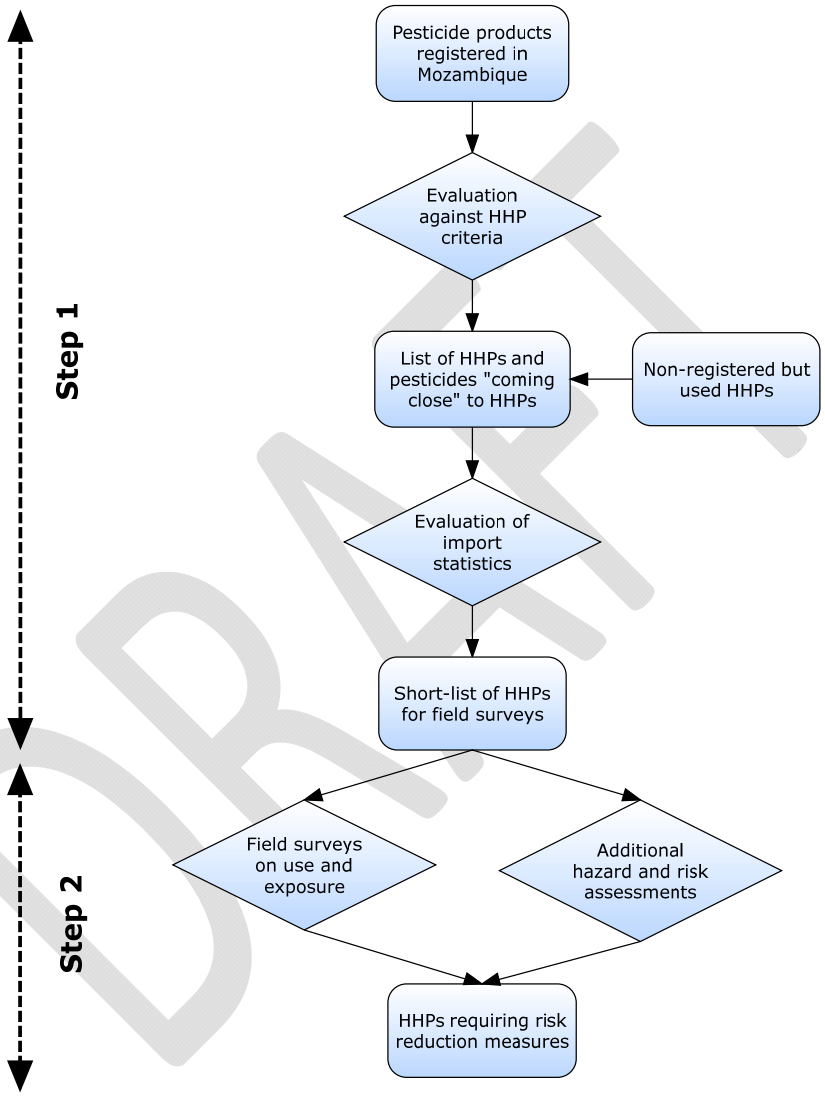

Figure 2. Schematic outline of the various activities in Steps 1 and 2 of the project. This report primarily covers Step 1.

2. Methodology

2.1 Criteria to define HHPs

The criteria that were used in this study to identify highly hazardous pesticides (HHPs) were those established by the FAO/WHO Joint Meeting on Pesticide Management (JMPM) (FAO/WHO, 2008). The JMPM recommended that HHPs should be defined as having one or more of the following characteristics:

- pesticide formulations that meet the criteria of classes Ia or Ib of the *WHO Recommended Classification of Pesticides by Hazard*;

  or

- pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

  or

- pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

  or

- pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

  or

- pesticide active ingredients listed by the *Stockholm Convention* in its Annexes A and B, and those meeting all the criteria in paragraph 1 of annex D of the Convention;

  or

- pesticide active ingredients and formulations listed by the *Rotterdam Convention* in its Annex III;

  or

- pesticides listed under the *Montreal Protocol*;

  or

- pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

The JMPM criteria above were used to establish a list of HHPs registered in Mozambique.

Added to this list were:

- Pesticides that are not registered in Mozambique anymore, but for which limited (left-over) quantities are still used in the country.
- Pesticides with characteristics which “come close” to the HHP criteria. A number of pesticides did not meet the WHO class criteria defined by the JMPM, but their acute or chronic toxicity “comes close” to the criteria limits, or they have been marked in the WHO classification as of particular concern with respect to their toxicity.

The following criteria were applied to identify such pesticides "coming close" to HHPs:

- For liquid formulations: pesticide products with an acute oral LD_{50}< 200 mg/kg or an acute dermal LD_{50}< 400 mg/kg (note that these are the Class Ib limits in the previous version of the WHO Classification (WHO, 2005)).
- For solid formulations: pesticide products with an acute oral LD_{50}< 100 mg/kg or an acute dermal LD_{50}< 200 mg/kg.
- Pesticides marked in the WHO classification as of particular concern with respect to chronic toxicity other than the CMR-criteria (*carcinogenicity-mutagenicity-reproductive toxicity*) listed in sections 2.2.4 to 2.2.6 below.
- Pesticides for which carcinogenicity evaluations by different registration/assessment authorities did not lead to consistent classification as GHS Category 1A or 1B, but which were, based on the evidence of one of these authorities, considered of particular concern for use in Mozambique.

2.2 Data collection

2.2.1 Introduction

In principle, the pesticide registration dossier should contain the information that is required for a responsible authority to identify whether a pesticide may be considered an HHP. However, in many developing countries, registration dossiers do not contain sufficient information for such an evaluation. And even if the information is provided in the dossier, the registration authority will often not have the technical capacity to assess the accuracy of the information or to evaluate submitted studies against all the JMPM criteria.

No international or national databases exist which list highly hazardous pesticides (HHPs) based on all the criteria listed by the JMPM. However, various databases are available for individual criteria. These include international databases, e.g. for the criteria linked to the Rotterdam and Stockholm Conventions, or for the *WHO Classification of pesticides by hazard*; others are national or regional, such as the classification and labelling of chemicals databases of the European Union.

In this study, registration dossiers submitted to the registration authority of Mozambique were used to assess pesticides against some of the HHP criteria. International databases or assessments, as well as national or regional databases of various reputable pesticide registration authorities, we accessed to review pesticides against other HHP criteria. The exact procedures for each of the HHP criteria are further described in the chapters below.

2.2.2 Starting data set

The initial dataset used for this study was the list of pesticides registered for use in Mozambique in June 2012, as provided by the Ministry of Agriculture of Mozambique (Minag, 2012). At that date, 646 formulated pesticide products were registered in the country

The 646 registered products contained 192 active substances, of which six were synergists or other additives, and nine others were microbial pesticides.

2.2.3 WHO hazard class

HHPs

The JMPM considers as HHP all *"Pesticide formulations that meet the criteria of classes Ia or Ib of the WHO Recommended Classification of Pesticides by Hazard"*. The latest version of the WHO Classification (WHO, 2010) is shown in Table 1.

Table 1. WHO classification of pesticides by hazard (WHO, 2010)

WHO Class		**LD_{50} for the rat** *(mg/kg body weight)*	
		Oral	**Dermal**
Ia	Extremely hazardous	< 5	< 50
Ib	Highly hazardous	5–50	50–200
II	Moderately hazardous	50–2000	200–2000
III	Slightly hazardous	> 2000	> 2000
U	Unlikely to present acute hazard	≥5000	

To evaluate this criterion, all pesticide formulations registered in Mozambique were classified against the WHO Classification. The oral and dermal LD_{50} value of the formulation, as provided in the registration dossier, was used as the basis for the classification.

In addition, for all formulations a theoretical LD_{50} was calculated, based on the LD_{50} value of the active ingredient(s) and its concentration(s) in the formulated product. LD_{50} values for the active ingredient were obtained from the WHO Classification or, if not listed, from the FootPrint Pesticides Properties Database (PPDB, 2012). This theoretical LD_{50} of the formulation was used in case there were no values in the registration dossier, or to check whether the LD_{50} values provided in the dossier appeared reasonable given the active ingredient content. LD_{50} values from the registration dossier which deviated greatly from the theoretical values were omitted from the analysis.

Whenever there were more products registered for the same active ingredient and concentration, and different LD_{50} values were reported for these pesticide formulations, the lowest LD_{50} value was used for final classification. If oral and dermal LD_{50} values resulted in different classifications, the more hazardous classification was retained for the pesticide product.

2.2.4 GHS carcinogenic hazard

The JMPM considers as HHP all *"Pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS)"*.

The carcinogenicity categories 1A and 1B are defined as by the GHS(2011) as shown in Table 2.

Table 2. Hazard categories for carcinogens, according to the GHS. See GHS (2011) for further details.

Category	Description
1	Known or presumed human carcinogen.
1A	Known to have carcinogenic potential for humans; the placing of a substance is large based on human evidence.
1B	Presumed to have carcinogenic potential for humans; the placing of a substance is largely based on animal evidence.
2	Suspected human carcinogen.

The GHS itself does not provide lists of pesticides and their classifications. Therefore, the following data sources were used to check whether a pesticide would meet GHS Class 1A or 1B for carcinogenicity:

i. The ***WHO Classification of Pesticides by Hazard*** (WHO, 2010)

The footnotes to the various tables were checked for references to carcinogenicity. If a pesticide was listed as carcinogenic in the WHO Classification, it was considered, for this assessment, to meet GHS carcinogenicity Category 1A or 1B.

ii. The ***IARC Monographs on the evaluation of carcinogenic risks to humans*** (IARC, 2012).

Pesticides classified as IARC Group 1 (*carcinogenic to humans*) and Group 2A (*probably carcinogenic to humans*) were considered, for this assessment, to meet GHS carcinogenicity Category 1A or 1B.

iii. The ***European Union Pesticides Database*** (EU, 2012)

This database provides information on plant protection products, but not on other pesticides (biocides). EU hazard classifications follow the GHS. Therefore, pesticides listed in this database as "*carc. 1A*" are GHS Category 1A, and those listed as "*carc. 1B*" are GHS Category 1B.

iv. The ***European Chemical Substances Information System (ESIS)***– *Database of Harmonized Classification and Labelling Elements (CLP/GHS)* (ESIS, 2012)

In addition to plant protection products, this database provides hazard classification informationon biocides. EU hazard classifications follow the GHS. Therefore, pesticides listed in this database as "*carc. 1A*" are GHS Category 1A, and those listed as "*carc. 1B*" are GHS Category 1B.

v. The US EPA evaluations of carcinogenic potential, as provided in the ***Integrated Risk Information System (IRIS)*** (IRIS, 2012).

For this assessment, the following correlations were assumed between the various EPA carcinogenicity classifications and the GHS carcinogenicity categories:

- 1986 guidelines: *"EPA class A (human carcinogen)"* were assumed to be GHS Category 1A, and *"EPA class B1 or B2 (probable human carcinogen)"*to be GHS Category 1B.
- 1996 guidelines: "*EPA known/likely carcinogen"* was assumed to be GHS Category 1A or 1B.

- 1999 guidelines: "*EPA carcinogenic"* was assumed to be GHS Category 1A and *EPA "likely carcinogenic* " was assumed to be GHS Category 1B.
- 2005 guidelines: *"EPA carcinogenic"* was assumed for this assessment to be GHS Category 1A and *"EPA likely carcinogenic"* was assumed to be GHS Category 1B.

vi. The list of **Chemicals Evaluated for Carcinogenic Potential,** compiled by the Office of Pesticide Programs of the US EPA (US-EPA, 2012a).

The same correlations were assumed as listed above (section v.) between the various EPA carcinogenicity classifications and the GHS carcinogenicity categories.

If pesticides were not covered by one or more of the previous sources, the data reviews mentioned below were verified:

vii. Pesticides evaluated by the FAO/WHO ***Joint Meeting on Pesticide Residues*** (JMPR, 2012).

The JMPR toxicology reviews were accessed for selected pesticides to check whether the pesticide is considered to be carcinogenic. Since no standardised carcinogenicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

viii. US EPA ***Pesticide Chemical Search*** (US-EPA, 2012b)

This database was accessed to obtain reviews for selected pesticides, generally *Pesticide Fact Sheets* or *Re-registration Eligibility Documents* (REDs). Since no standardised carcinogenicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

ix. WHO ***Specifications for pesticides used in public health*** (WHO, 2012)

For a limited number of pesticides, the *WHO Specifications for pesticides used in public health*(new procedure) were accessed. Since no standardised carcinogenicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

In principle, if one of these data sources classified a pesticide as (equivalent to) GHS Categories 1À or 1B, the pesticide was considered a HHP. Only if the positive classification appeared outdated, and more recent comprehensive reviews or classifications were available showing that the pesticide was not carcinogenic, the pesticide was not considered a HHP based on this criterion.

2.2.5 GHS mutagenic hazard

The JMPM considers as HHP all *"Pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS)"*

The mutagenicity categories 1A and 1B are defined as by the GHS (2011) as shown in Table 3.

Table 3. Hazard categories for mutagens, according to the GHS. See GHS (2011) for further details.

Category	Description
1	Substances known to induce heritable mutations or to be regarded as if they induce heritable mutations in the germ cells of humans.
1A	Substances known to induce heritable mutations in germ cells of humans.
1B	Substances which should be regarded as if they induce heritable mutations in the germ cells of humans.
2	Substances which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans.

The GHS itself does not provide lists of pesticides and their classifications. Therefore, the following data sources were used to check whether a pesticide would meet GHS Class 1A or 1B for germ cell mutagenicity.

i. The ***WHO Classification of Pesticides by Hazard*** (WHO, 2010)

The footnotes to the various tables were checked for references to mutagenicity. If a pesticide was listed as mutagenic in the WHO Classification, it was considered, for this assessment, to meet GHS mutagenicity Category 1A or 1B.

ii. The ***European Union Pesticides Database*** (EU, 2012)

This database provides information on plant protection products, but not on other pesticides (biocides). EU hazard classifications follow the GHS. Therefore, pesticides listed in this database as "*muta. 1A*" are GHS Category 1A, and those listed as "*muta. 1B*" are GHS Category 1B.

iii. The ***European Chemical Substances Information System (ESIS)*** – *Database of Harmonized Classification and Labelling Elements (CLP/GHS)* (ESIS, 2012)

In addition to plant protection products, this database provides hazard classification information on biocides. EU hazard classifications follow the GHS. Therefore, pesticides listed in this database as "*muta. 1A*" are GHS Category 1A, and those listed as "*muta. 1B*" are GHS Category 1B.

If pesticides were not covered by one or more of the previous sources, the data reviews mentioned below were verified:

iv. Pesticides evaluated by the FAO/WHO ***Joint Meeting on Pesticide Residues*** (JMPR, 2012).

The JMPR toxicology reviews were accessed for selected pesticides to check whether the pesticide is considered to be germ cell mutagens. Since no standardised mutagenicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

v. US EPA ***Pesticide Chemical Search*** (US-EPA, 2012b)

This database was accessed to obtain reviews for selected pesticides, generally *Pesticide Fact Sheets* or *Re-registration Eligibility Documents* (REDs). Since no standardised mutagenicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

vi.. WHO ***Specifications for pesticides used in public health*** (WHO, 2012)

For a limited number of pesticides, the *WHO Specifications for pesticides used in public health*(new procedure) were accessed. Since no standardised mutagenicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

In principle, if one of these data sources classified a pesticide as (equivalent to) GHS Categories 1À or 1B, the pesticide was considered a HHP. Only if the positive classification appeared outdated, and more recent comprehensive reviews or classifications were available showing that the pesticide was not a germ cell mutagen, the pesticide was not considered a HHP based on this criterion.

2.2.6 GHS reproductive toxicity hazard

The JMPM considers as HHP all "*Pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS)"*

The reproductive toxicity categories 1A and 1B are defined as by the GHS (2011) as shown in Table 4.

Table 4. Hazard categories for reproductive toxicants, according to the GHS. See GHS (2011) for further details.

Category	Description
1	Known or presumed human reproductive toxicant
1A	Known human reproductive toxicant
1B	Presumed human reproductive toxicant
2	Suspected human reproductive toxicant

The GHS itself does not provide lists of pesticides and their classifications. Therefore, the following data sources were used to check whether a pesticide would meet GHS Class 1A or 1B for reproductive toxicity.

i. The ***WHO Classification of Pesticides by Hazard*** (WHO, 2010)

The footnotes to the various tables were checked for references to reproductive toxicity. If a pesticide was listed as a reproductive toxicant in the WHO Classification, it was considered, for this assessment, to meet GHS reproductive toxicity Category 1A or 1B.

ii. The ***European Union Pesticides Database*** (EU, 2012)

This database provides information on plant protection products, but not on other pesticides (biocides). EU hazard classifications follow the GHS. Therefore, pesticides listed in this database as "*repro. 1A*" are GHS Category 1A, and those listed as "*repro. 1B*" are GHS Category 1B.

iii. The ***European Chemical Substances Information System (ESIS)*** – *Database of Harmonized Classification and Labelling Elements (CLP/GHS)* (ESIS, 2012)

In addition to plant protection products, this database provides hazard classification information on biocides. EU hazard classifications follow the GHS. Therefore, pesticides listed in this database as "*repro. 1A*" are GHS Category 1A, and those listed as "*repro. 1B*" are GHS Category 1B.

If pesticides were not covered by one or more of the previous sources, the data reviews mentioned below were verified:

iv. Pesticides evaluated by the FAO/WHO ***Joint Meeting on Pesticide Residues*** (JMPR, 2012).

The JMPR toxicology reviews were accessed for selected pesticides to check whether the pesticide is considered to be a reproductive toxicant. Since no standardised reproduction toxicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

v. US EPA ***Pesticide Chemical Search*** (US-EPA, 2012b)

This database was accessed to obtain reviews for selected pesticides, generally *Pesticide Fact Sheets* or *Re-registration Eligibility Documents* (REDs). Since no standardised reproduction toxicity classification is used in these reviews, pesticides were assessed on a case-by-case basis.

vi. WHO ***Specifications for pesticides used in public health*** (WHO, 2012)
For a limited number of pesticides, the *WHO Specifications for pesticides used in public health* (new procedure) were accessed. Since no standardised classification for reproductive toxicants is used in these reviews, pesticides were assessed on a case-by-case basis.

In principle, if one of these data sources classified a pesticide as (equivalent to) GHS Categories 1À or 1B, the pesticide was considered a HHP. Only if the positive classification appeared outdated, and more recent comprehensive reviews or classifications were available showing that the pesticide was not a reproductive toxicant, the pesticide was not considered a HHP based on this criterion.

2.2.7 Stockholm Convention

The JMPM considers as HHP all *"Pesticide active ingredients listed by the Stockholm Convention in its Annexes A and B, and those meeting all the criteria in paragraph 1 of Annex D of the Convention"*

Pesticides listed in Annex A and B were obtained directly from the Convention web site (Stockholm, 2012).

Annex D of the Stockholm Convention lists the screening criteria for inclusion of a pesticide in Annex A, B and/or C of the Convention (Stockholm, 2009). With respect to Annex D, the Stockholm Convention stipulates in its Article 3, that :

> **3.** *Each Party that has one or more regulatory and assessment schemes for new pesticides or new industrial chemicals shall take measures to regulate with the aim of preventing the production and use of new pesticides or new industrial chemicals which, taking into consideration the criteria in paragraph 1 of Annex D, exhibit the characteristics of persistent organic pollutants.*
>
> **4.** *Each Party that has one or more regulatory and assessment schemes for pesticides or industrial chemicals shall, where appropriate, take into consideration within these schemes the criteria in paragraph 1 of Annex D when conducting assessments of pesticides or industrial chemicals currently in use.*

Therefore, and in particular to meet Article 3.4 above, all pesticides registered in Mozambique were reviewed against the criteria listed in Annex D. The screening criteria that identify a POP, as defined in paragraph1 of Annex D are listed in Table 5.

For each of the registered pesticides, the data were compiled using the FootPrint Pesticide Properties Database (PPDB, 2012), as follows:

Persistence

- Half-life (DT_{50}) in water: aqueous photolysis DT_{50}; aqueous hydrolysis DT_{50}, and water phase only DT_{50} of the water-sediment study. The latter parameter, or any listed field data, had preference in the assessment of persistence in water. The range of relevant values was noted in the evaluation spreadsheet.
- Half-life (DT_{50}) in soil: DT_{50} (typical), DT_{50} (lab), DT_{50} (field), any DT_{50} values (lab or field) given in the "note" to this section in FootPrint. Any listed field data had preference in the assessment of persistence in soil. The range of relevant values was noted in the evaluation spreadsheet.
- Half-life (DT_{50}) in sediment: Water-Sediment DT_{50}

Table 5. Screening criteria to identify a Persistent Organic Pollutant (POP) according to the Stockholm Convention (Annex D) (Stockholm, 2009)

Characteristic	Criteria	
b. Persistence	(i)	Evidence that the half-life of the chemical in water is greater than two months, or that its half-life in soil is greater than six months, or that its half-life in sediment is greater than six months; or
	(ii)	Evidence that the chemical is otherwise sufficiently persistent to justify its consideration within the scope of this Convention;
c. Bio-accumulation	(i)	Evidence that the bio-concentration factor or bio-accumulation factor in aquatic species for the chemical is greater than 5,000 or, in the absence of such data, that the log K_{ow} is greater than 5;
	(ii)	Evidence that a chemical presents other reasons for concern, such as high bio-accumulation in other species, high toxicity or ecotoxicity; or
	(iii)	Monitoring data in biota indicating that the bio-accumulation potential of the chemical is sufficient to justify its consideration within the scope of this Convention;
d. Potential for long-range environmental transport	(i)	Measured levels of the chemical in locations distant from the sources of its release that are of potential concern;
	(ii)	Monitoring data showing that long-range environmental transport of the chemical, with the potential for transfer to a receiving environment, may have occurred via air, water or migratory species; or
	(iii)	Environmental fate properties and/or model results that demonstrate that the chemical has a potential for long-range environmental transport through air, water or migratory species, with the potential for transfer to a receiving environment in locations distant from the sources of its release. For a chemical that migrates significantly through the air, its half-life in air should be greater than two days; and
e. Adverse effects	(i)	Evidence of adverse effects to human health or to the environment that justifies consideration of the chemical within the scope of this Convention; or
	(ii)	Toxicity or ecotoxicity data that indicate the potential for damage to human health or to the environment.

Bioaccumulation

- Octanol–water partition coefficient – log K_{ow} (= log P in FootPrint).
- Bioconcentration factor in aquatic species (BCF).
- Bioacummulation factor in aquatic species (BAF) (if listed).
- Bioacummulation factor in other species (BAF) (if listed).

Potential for long-range transport

- This characteristic was not assessed, as it was not considered relevant for the identification of HHPs in Mozambique itself.

Adverse effects

- This characteristic was only assessed for pesticides which were both persistent and bioaccumulative according to the criteria listed above. For this study, such pesticides were considered HHPs if they fell in WHO hazard class II or higher.
- No other toxicity or ecotoxicity assessments were conducted to assess whether there was "potential for damage to human health or to the environment".

2.2.8 Rotterdam Convention

The JMPM considers as HHP all *"Pesticide active ingredients and formulations listed by the Rotterdam Convention in its Annex III"*.

Pesticides listed in Annex III were obtained directly from the Convention web site (Rotterdam, 2012)

2.2.9 Montreal Protocol

The JMPM considers as HHP all *"Pesticides listed under the Montreal Protocol"*.

The only pesticide presently listed under the Montreal Protocol is methyl bromide (Montreal, 2012)

2.2.10 High incidence of severe or irreversible adverse effects

The JMPM considers as HHP all *"Pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment"*.

This parameter was not assessed in Step 1 of the project, as it requires information from actual use in Mozambique, or from similar use situations. Pesticide use surveys have been programmed for Step 2 of the project, however.

2.2.11 Import statistics

Import statistics were obtained from the Pesticide Registration Section of the Ministry of Agriculture. Mozambique applies an import permit system and all official pesticide imports are registration by the Ministry of Agriculture. While such a system does not allow for records of illegal imports, the import register in Mozambique is generally considered to represent a large fraction of pesticides entering the country. No local pesticide manufacturing or formulation takes place in Mozambique.

For this study, the import statistics of 2010, 2011 and the first half of 2012 were reviewed. Total quantities imported during that period for all products with the same active ingredient(s) were considered a proxy for the present use of that active ingredient in the country. Implicitly, it was assumed that pesticides imported before 2010 would have been used up by the time of the study and not be used anymore.

2.3 Data compilation

All assessments made and data compiled as described in the sections above were compiled in a spreadsheet. This was done to allow full transparency with respect to the identification process of the HHPs, but also to allow updating of the list of HHPs would new information become available. The latest version of the spreadsheet is available on request. This version does not contain the detailed import statistics, however, as these are considered confidential.

3. Results

3.1 Data availability

Using the data sources laid out in Chapter 2, it was possible to review all HHP criteria defined by the JMPM for most of the pesticides registered in Mozambique, except for the last criterion, which refers to pesticides that have shown a high incidence of severe or irreversible adverse effects – see Section 2.2.10).

Acute toxicity

LD_{50} values for the pesticide formulations were provided in the registration dossier for 97% (oral LD_{50}) and 93% (dermal LD_{50}) of the registered products. However, in some cases the LD_{50} values of the formulation appeared erroneous when compare to the theoretical values calculated on the basis of the a.i.; in others, the LD_{50} of the formulation provided by the registrar was identical to the a.i. In total, 12% of the oral LD_{50} values for the formulations were either not reported in the dossier or were considered erroneous; this was the case for 10% of the dermal LD_{50} values. However, in many cases, LD_{50} values of the formulation could be estimated based on the LD_{50} values of the a.i.

As a result, LD_{50} values for the formulation were available or could be estimated for all registered pesticide products except for three microbial pesticides and one citronella oil (i.e. > 99% of the total).

Overall, data availability for acute toxicity, which is at the basis of the WHO Class criterion of the JMPM, can be considered satisfactory.

Carcinogenicity, mutagenicity, reproductive toxicity (CMR)

Evaluations on carcinogenic potential were available for 93% of the active ingredients registered in Mozambique, representing 96% of the number of registered formulated products. Of the 11 a.i.'s lacking carcinogenicity evaluations, four were adjuvants/synergists, one a repellent, one a microbial pesticide and one a pheromone; the remaining four were "regular" chemical pesticides.

Evaluations on germ cell mutagenicity were available for 90% of the active ingredients registered in Mozambique, representing 95% of the number of registered formulated products. Of the 20 a.i.'s lacking carcinogenicity evaluations, four were adjuvants/synergists, three repellents, one a microbial pesticide and one a pheromone; the remaining 11 were "regular" chemical pesticides.

Evaluations on reproductive toxicity were available also for 90% of the active ingredients registered in Mozambique, representing 94% of the number of registered formulated products. Of the 20 a.i.'s lacking reproductive toxicity evaluations, four were adjuvants/synergists, two repellents, one a microbial pesticide and one a pheromone; the remaining 12 were "regular" chemical pesticides.

Overall, data to evaluate the CMR criteria of the JMPM were available for >90% of the a.i. and >94% of registered formulations. Eight to twelve active ingredients of "regular" chemical pesticide a.i.'s had not been evaluated and/or classified for CMR criteria by any of the used sources. It can certainly not be excluded that evaluation of other data sources would result in proper classification of these a.i.'s, but that was not further attempted in this study.

Rotterdam and Stockholm Conventions, and Montreal Protocol

Inclusion in the lists of regulated chemicals of these three international instruments was obviously complete and did not show any data gaps.

On the other hand, there were data gaps in the parameters needed to classify a pesticide as a POP according to Annex D of the Stockholm Convention. Only one data source was used to obtain this information, the FootPrint Pesticide Properties Database. However, since the FootPrint database compiles its data from various reputable reviews and databases, it is generally considered to be rather complete.

In spite of the extensiveness of the FootPrint database, for 36 a.i.'s (19% of the total) half-lives in water were not available. In many cases this absence was understandable (e.g. for microbial pesticides, repellents, pheromones), but for 17 a.i.'s of "regular" chemical pesticides registered in Mozambique, this information was not present either.

Half-lives in soil were available for more pesticides in the FootPrint database. Data were lacking for 27 a.i.'s (15% of the total), of which eight were "regular" chemical pesticides registered in Mozambique.

In contrast, half-life data for sediments (water-sediment studies) were not available for 42% of the a.i.'s. This included 58 "regular" chemical pesticide a.i.'s for which data were lacking. This is not entirely surprising, as water-sediment studies are fairly recent requirements in pesticide registration in Europe and the U.S.

Bioaccumulation potential is assessed using the bioconcentration factor (BCF) for aquatic organisms, or the bioaccumulation factor (BAF) for aquatic or terrestrial organisms. BAFs were not available in FootPrint for any of the registered a.i.'s. BCFs were not available for 76 a.i.'s (40% of the total).

In the absence of BCFs, the octanol-water partition coefficient (K_{ow} or P) of the pesticide is used to evaluate bioaccumulation potential. K_{ow}-values were available for most pesticides, with data absent for only 21 a.i.'s (10% of the total), most of which were microbial pesticides, synergists or adjuvants, and pheromones.

Based on the above, it may be concluded that for the majority of pesticides registered in Mozambique it was possible to assess whether a pesticide is persistent or bioaccumulative according to the Stockholm Convention, but that there were still considerable data gaps.

3.2 Identification of HHPs

Taking into account the limitations due to data gaps described above, in total 57 registered pesticide formulations, containing 24 active ingredients, were identified as HHPs. In addition, two pesticides were also listed as HHP: DDT and methyl-bromide (Figure 3). The latter two pesticides are not registered in Mozambique anymore, but remaining stocks are still being used (for DDT) or their use is still temporarily being allowed (for methyl bromide). Further details for all identified HHPs are provided in Table 6.

The majority of HHPs were identified on the basis of their acute toxicity. Thirty-seven out of 59 formulated products were WHO class Ia or Ib (based on acute toxicity; not on chronic), or highly toxic by inhalation (Figure 4).

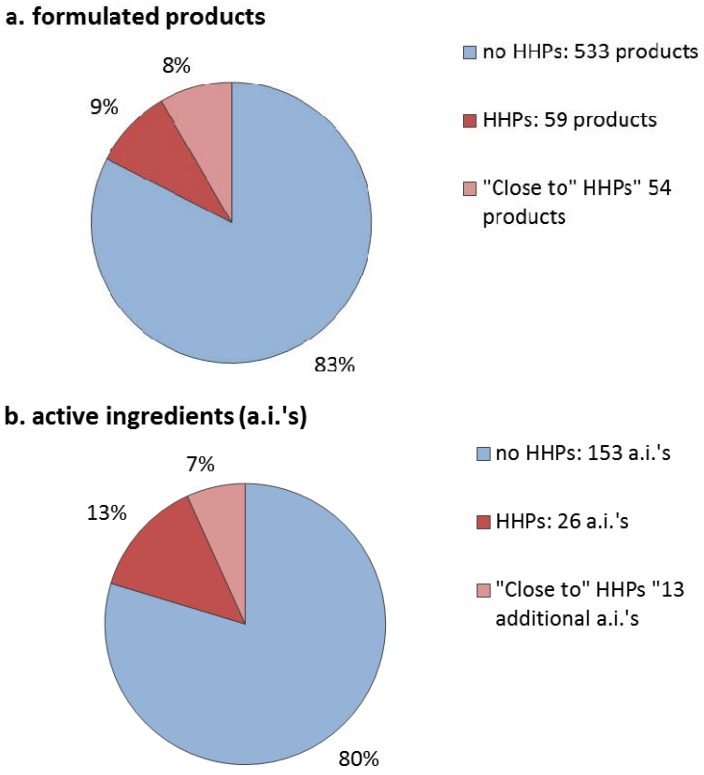

Figure 3. The number and percentage of identified highly hazardous pesticides (HHPs), pesticides "close to HHPs" in Mozambique. a. formulated products (total = 646), and b. active ingredients (a.i.'s) (total = 192).

The second most important criterion was listing in Annex III of the Rotterdam Convention (Figure 4). This was the case for 17 out of 59 formulated products, or 6 out of 26 active ingredients identified as HHP.

Two active ingredients, representing 5 pesticide products, were listed in Annex A or B of the Stockholm Convention. Three other pesticide active ingredients were both persistent and bioaccumulative according to Annex D criteria (diafenthiuron, difenacoum and difethialone), but only diafenthiuron is moderately toxic to humans. Furthermore, the insecticide diafenthiuron is considered hazardous to aquatic organisms while difenacoum and difethialone, both rodenticides, are considered hazardous to aquatic organisms as well as to birds and mammals. While this does not mean that these organisms will be unacceptably affected when the pesticides are applied, the "potential for damage to the environment" exists (as indicated in Annex D of the Stockholm Convention), and these pesticides were therefore identified as HHPs in Table 6.

One pesticide was listed under the Montreal Protocol.

Two active ingredients were classified as GHS Category 1A & 1B carcinogen, three a.i.'s as mutagen and three a.i.'s as reproductive toxicant. For 14 active ingredients, carcinogenicity evaluations by the EU and the US-EPA did not lead to the same conclusion with respect to classification; these were further evaluated under Section 3.3.

In total, seven active ingredients met more than one JMPM HHP criterion (Table 6).

Table 6. Highly hazardous pesticides (HHPs) identified among the pesticide products registered in Mozambique, and pesticide products "coming close" to being considered HHPs. For the selection criteria and the applied methodology see Chapter 2 of this report.

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
Pesticides meeting the HHP criteria							
455	Controler 48% SE	Alachlor 336 g/l (+ Atrazine 144 g/l)	Rott. Annex III	Maize, sunflower, soybean, groundnut, vegetables	0		EU: No (H[2]& E[3]) USA: Yes
666	Volcano alachlor 48% EC	Alachlor 480 g/l	Rott. Annex III				
509	Seter 48% EC	Alachlor 480 g/l	Rott. Annex III				
644	Volcano Aldicarb 15% GR	Aldicarb 150 g/kg	WHO Ib; Rott. Annex III	Citrus (nurseries)	0		EU: No (E) USA: Yes, but being phased out (H & E)
1172	Fumate 56% FT	Aluminium Phosphide 560 g/kg	Highly toxic by inhalation	Storage insect pests of: tobacco, cereals, groundnut, oilseeds	29844 kg (2010) 14690 kg (2011) 1311 kg (2012) 705 (2013)		EU: Yes USA: Yes
1054	Moz Aluminium Phosphide Pellets	Aluminium Phosphide 560 g/kg	Highly toxic by inhalation				
581	Phosgard 56% FT	Aluminium phosphide 560 g/kg	Highly toxic by inhalation				
773	Falfume 57% FT	Aluminium Phosphide 570 g/kg	Highly toxic by inhalation				
1071	Moz Aluminium Phosphide Tablets	Aluminium Phosphide 570 g/kg	Highly toxic by inhalation				
1129	Quickphos 57% FT	Aluminium Phosphide 570 g/kg	Highly toxic by inhalation				
1080	Biophos 57% FW	Aluminium phosphide 570 g/kg	Highly toxic by inhalation				
1028	Celphos 57% FT	Aluminium phosphide 570 g/kg	Highly toxic by inhalation				
664	Volcano Aluminium Phosphide 57% FT	Aluminium phosphide 570 g/kg	Highly toxic by inhalation				
467	Benopec 50% WP	Benomyl 500 g/kg	Mutagen; reproductive toxicant	Apple, pineapple	5600 kg (2010)		EU: No (H & E) USA: No; voluntary

[1] EU (2012) and US-EPA (2012b), checked on 26 October 2012

[2] H = not registered due to unacceptable risk to human health

[3] E = not registered due to unacceptable risk to the environment

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
772	Volcano Demeter 50% WP	Benomyl 500 g/kg	Mutagen; reproductive toxicant		2000 kg (2012)		cancellation (H)
793	Supa-Kill Líquid Rat and Mouse Bait	Brodifacoum 0,75 g/L	WHO class Ib	Rodents	40 L (2011) 28 L (2012)	Also formulation with lower concentration registered	EU: No (NS[4]) USA:Yes
952	Brokir 0,075% CB	Brodifacoum 0,75 g/L	WHO class Ib				
837	Rodex Profissional Líquid Concentrate	Brodifacoum 2,5 g/kg	WHO class Ib				
681	Duett 25% SC	Carbendazim 125 g/l (+ Epoxiconazole 125 g/l)	Mutagen; reproductive toxicant	Cereals, groundnut	5 L (2011)		EU: Yes USA:Yes
126	Curaterr 10% GR	Carbofuran 100 g/kg	WHO class Ib	Maize, sugarcane	0		EU: No (H & E) USA:No; cancellation in progress (H & E)
504	Carbofurão 5% GR	Carbofuran 50 g/kg	WHO class Ib				
254	Polo 50% SC	Diafenthiuron 500 g/l	Stockh. Annex D (persistent, bioaccumulative and potential for damage to the humans or the environment)	Beans, cucumber, pepper, tomato, potato	0		EU: No (NS) USA: No
1202	Divos 100% EC	Dichlorvos 1000 g/l	WHO class Ib	Flowers, vegetables, stored cereals, domestic uses, veterinary uses	448 L (2010) 3000 L (2011) 2400 L (2012) 2584 (2013)		EU: No (H) USA:Yes
984	Nuvan 100% EC	Dichlorvos 1000 g/l	WHO class Ib				
774	Falcovos 100% EC	Dichlorvos 1000 g/l	WHO class Ib				
984	Nuvam 100% EC	Dichlorvos 1000 g/l	WHO class Ib				
1220	Diclofop–methyl 37,8% EC	Diclofop–methyl 378 g/l	carcinogen	Wheat, barley, triticale, peas	0		EU: Yes USA:Yes
1055	Moz Tornado 0,01% BB	Difenacoum 0,1 g/kg	Stockh. Annex D (persistent, bioaccumulative and potential for damage to the environment)	Rodents	48 (2013)		EU: Yes USA: Yes

[4] NS = not registered because no (complete) dossier was submitted

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
944	Finale Rat And Mouse Grain Bait	Difethialone 0,025 g/kg	Stockh. Annex D (persistent, bioaccumulative and potential for damage to the environment)	Rodents	0		EU: No (NS) USA: Yes
969	Finale Rat And Mouse Pellets	Difethialone 0,025 g/kg	Stockh. Annex D (persistent, bioaccumulative and potential for damage to the environment)				
943	Finale Rat And Mouse Wax Bait	Difethialone 0,025 g/kg	Stockh. Annex D (persistent, bioaccumulative and potential for damage to the environment)				
719	Ratex Pellts	Difethialone 0,025 g/kg	Stockh. Annex D (persistent, bioaccumulative and potential for damage to the environment)				
1027	Endocel 35% EC	Endosulfan 350 g/l	Stockh. Annex A; Rott. Annex III	Cotton, cocoa, cereals, vegetables, flowers,	2585 L (2010) 7280 L (2011) 9150 L (2012)		EU: No (H & E) USA:Yes,but phase out in progress
447	Endopec 35% EC	Endosulfan 350 g/l	Stockh. Annex A; Rott. Annex III				
825	Enticer 35% EC	Endosulfan 350 g/l	Stockh. Annex A; Rott. Annex III				
605	Volcano Endosulfão 35% EC	Endosulfan 350 g/l	Stockh. Annex A; Rott. Annex III				
518	Eticide 101% EC	Ethion 1010 g/l	WHO class Ib	Veterinary use	0		EU: No (NS) USA:No; voluntary cancellation (H)
483	Nemacur 40% EC	Fenamiphos 400 g/l	WHO class Ib	Tobacco, citrus, vegetables, potato, groundnut, grape, peach, pineapple	30 L (2013)	Also a granular formulation with lower hazard registered	EU: Yes USA: Voluntary cancellation (H & E)
715	Volamiphos 40% EC	Fenamiphos 400 g/l	WHO class Ib				
1056	Moz Fenamiphos 400 SC	Fenamiphos 400 g/l	WHO class Ib				

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
1115	Vet Fume B	Formaldehyde 370 g/l	Carcinogen	Disinfectant	1660 (2010) 4060 (2011) 1910 (2012) 3525 (2013)		EU: No (NS) USA:Yes
746	Crop Guard 90% EC	Furfural 900 g/l	WHO class Ib	Vegetables, tobacco, flowers, maize, groundnut	200 (2013)		EU: No (NS) USA: Yes
1163	Chemaron 58% SL	Methamidophos 585 g/l	WHO Ib; Rott. Annex III	Cotton, tobacco, vegetables	34760 L (2010) 13050 L (2011) 37832 L (2012) 28556 L (2013)		EU: No (RE)[5] USA:No; voluntary cancellation
1163	Chemeron 58% SL	Methamidophos 585 g/l	WHO Ib; Rott. Annex III				
1199	Sniper 58.5% SL	Methamidophos 585 g/l	WHO Ib; Rott. Annex III				
639	Volmet 58,5% SL	Methamidophos 585 g/l	WHO Ib; Rott. Annex III				
361	Mesurol 80 WP	Methiocarb 800 g/kg	WHO class Ib	Maize, groundnut, potato, vegetables, citrus	0	Also formulation with lower concentration registered	EU: Yes USA: Yes
1198	Methomex 90% SP	Methomyl 900 g/kg	WHO class Ib	Vegetables, tobacco, cereals, flowers	500 kg (2012) 1000 kg (2013)	Also formulation with lower concentration registered	EU: Yes USA: Yes
480	Delta Super 25,75% EC	Monocrotophos 250 g/l (+ Deltamethrin 7,5 g/l)	Rott. Annex III	Cotton, maize, tobacco	0		EU: No (NS) USA: No (cancelled in 1991)
478	Zipper Super 28% EC	Monocrotophos 250 g/l (+ Cypermethrin 30 g/l)	Rott. Annex III				
454	Monopec 40% SL	Monocrotophos 400 g/l	WHO Ib; Rott. Annex III				
1151	Monocrotophos 40% EC	Monocrotophos 400 g/l	WHO Ib; Rott. Annex III				
1185	Oxadate 31% SL	Oxamyl 310 g/l	WHO class Ib	Tobacco, sugarcane,	500 kg (2010)		EU: Yes

[5] RE = not registered because registration expired and was not renewed

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
810	Vydate 31% SL	Oxamyl 310 g/l	WHO class Ib	fruits, vegetables, groundnut	300 kg (2011) 400 kg (2012)		USA: Yes
1065	Moz Terbufos 15% GR	Terbufos 150 g/kg	WHO class Ia	Maize, sorghum, potato, beans	0		EU: No (NS) USA:Yes
1167	Ratikill 80% AB	Zinc phosphide 800 g/kg	WHO class Ib	Rodents	0		EU: Yes USA:Yes
822	Ratil 80% AB	Zinc phosphide 800 g/kg	WHO class Ib				
Total	***[57**/646]***	***[24**/225]***					
Pesticides not registered, but used in Mozambique and complying with the HHP criteria							
--	DDT 50% WP	DDT	Stockh. Annex B; Rott. Annex III	Malaria mosquito control	0 (but use of existing stocks)		EU: No (P)[6] USA: No
--	Brometo de metilo	Methyl bromide	Montreal Protocol	Quarantine treatments (stored products)	0 (but use of existing stocks)		EU: No (H) USA: Yes
Total		***[2]***					
Registered pesticides not complying with the JMPM criteria, but "coming close"							
570	Volcano 2,4 D 72% SL	2,4-D dimethylamine 720 g/l	WHO class II, but dermal hazard close to Ib	Sugar cane, coffee, cocoa, rice, palm trees.	47000 L (2010) 32600 L (2011) 52000 L (2012) 19600 L (2013)		EU: No USA: Yes
1063	Moz Paraquat 20% SL	Paraquat 200 g/l	WHO Class II but chronic toxicity alert; dermal hazard close to Class Ib; very low AOEL[7]	Forestry, fruits, vegetables, cotton, coffee, tea, flowers, banana, sugar cane,	22700 L (2010) 35100 L (2011) 17952 L (2012)		EU: No (A)[8] USA: Yes

[6] P = not registered because all use is prohibited in the EU

[7] AOEL = Acceptable Operator Exposure Level

[8] A= not registered because registration annulled by the Court

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
1303	Paracot 20% SL	Paraquat 200 g/l	WHO Class II but chronic toxicity alert; dermal hazard close to Class Ib; very low AOEL	pasture, potato	18440 L (2013)		
1262	Para-Cure 20% SL	Paraquat 200 g/l	WHO Class II but chronic toxicity alert; dermal hazard close to Class Ib; very low AOEL				
458	Paraxone 20% SL	Paraquat 200 g/l	WHO Class II but chronic toxicity alert; dermal hazard close to Class Ib; very low AOEL				
764	Volquato 20% SL	Paraquat 200 g/l	WHO Class II but chronic toxicity alert; dermal hazard close to Class Ib; very low AOEL				
1181	Gramozat 20% SL	Paraquat 200 g/l	WHO Class II but chronic toxicity alert; dermal hazard close to Class Ib; very low AOEL				
544	Ficam 80% WP	Bendiocarb 800 g/kg	WHO class II, but oral hazard close to Class Ib	Malaria mosquito control	5810 kg (2010) 14560 kg (2011) 30000 kg (2013)		EU: No (NS) USA: No; voluntary cancellation
735	Tocaia 80% WP	Bendiocarb 800 g/kg	WHO class II, but oral hazard close to Class Ib				
884	Avisnail 5% RB	Carbaryl 20 g/kg (+metaldehyde 30 g/kg	Carcinogen (see Annex I)	Cotton, potato, maize, sorghum, tobacco, groundnut, vegetables	400 kg (2010) 4200 kg (2011) 2200 kg (2012) 2600 kg (2013)		EU: No (H & E) USA: Yes
811	Supona 30% EC	Chlorfenvinphos 300 g/l	WHO class II, but oral hazard close to Class Ib	Veterinary uses	600 L (2012) 812 L (2013)		EU: No (NS) USA: No

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
816	Dazzel N.F 30% EC	Diazinon 300 g/l	WHO class II, but dermal hazard close to Class Ib	Veterinary uses	18 L (2010) 24 L (2011) 30 L (2012) 64 L (2013)		EU: No (H) USA: Yes
1155	Dichlorvos 10% EC	Dichlorvos (DDVP)100 g/l	WHO class II, but dermal and oral hazard close to Class Ib	Stored grains, vegetables, domestic use, veterinary use	1411 L (2010) 1462 L (2011) 2400 L (2012) 4000 L (2013)	More concentrated formulations in HHP shortlist above.	EU: No (H) USA: Yes
985	Nuvan Profi 12,4% AE	Dichlorvos 124 g/l	WHO class II, but dermal and oral hazard close to Class Ib				
986	Metrad 75% WG	Diuron 400 g/kg (+metribuzin 360 g/kg)	Carcinogen (see Annex I)	Sugarcane, cotton, macadamia nuts, coffee, banana, pineapple, wheat, tea, coconut, fruits trees, cocoa, rubber tree, industrials areas	47368 L (2010) 54140 L (2011) 58900 L (2012) 44660 L (2013)		EU: Yes USA: Yes
461	Dipec 80% WP	Diuron 800 g/kg	Carcinogen (see Annex I)				
849	Volcano Diuron 80% WG	Diuron 800 g/kg	Carcinogen (see Annex I)				
532	Volcano Diurão 800 SC	Diuron 800 g/l	Carcinogen (see Annex I)				
1061	Moz Diuron 80% SC	Diuron 800 g/l	Carcinogen (see Annex I)				
1211	Iprodione 25,5% SC	Iprodione 255 g/l	Carcinogen (see Annex I)	Vines, fruit trees, vegetables	12 L (2013)		EU: Yes USA: Yes
1101	Milthane Super 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)	Tobacco, vegetables, pineapple, ornamentals, fruit trees, potato, groundnut, vines , cereals, nuts, olive, coffee, soybean	68890 kg (2010) 77740 kg (2011) 30500 kg (2012) 59570 kg (2013)		EU: Yes USA: Yes
663	Volcano Crater MX 70% WP	Mancozeb 100 g/kg (+metalaxyl 600 g/kg)	Carcinogen (see Annex I)				
508	Etylit MZ 70% WP	Mancozeb 350 g/kg (+fosetyl-aluminium 350 g/kg)	Carcinogen (see Annex I)				
1236	Crater 455 SC	Mancozeb 455 g/l	Carcinogen (see Annex I)				
477	Megatop 50,5% WP	Mancozeb 465 g/kg (+cymoxanil 40 g/kg)	Carcinogen (see Annex I)				
1075	Dithane NT 60% OS	Mancozeb 600 g/kg	Carcinogen (see Annex I)				

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
875	Volcano Crater MX 72% WP	Mancozeb 640 g/kg (+ Metalaxyl 80 g/kg)	Carcinogen (see Annex I)				
546	Ridomil Gold 68% WP	Mancozeb 640 g/kg (+metalaxyl 40 g/kg)	Carcinogen (see Annex I)				
472	Ekyp MZ 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)	Carcinogen (see Annex I)				
823	Mascot 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)	Carcinogen (see Annex I)				
1136	Metaman FAE PM 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)	Carcinogen (see Annex I)				
1087	Neltylxyl 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)	Carcinogen (see Annex I)				
844	Ridomil Gold MZ 68 WG	Mancozeb 640 g/kg (+metalaxyl-M 40 g/kg)	Carcinogen (see Annex I)				
1045	Moz Controller	Mancozeb 700 g/kg (+cymoxanil 60 g/kg)	Carcinogen (see Annex I)				
1307	Cotzeb 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
1162	Curethane 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
1078	Dithane NT 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
1143	Mazole 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
1133	Policar MZ 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
1221	Ventum 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
534	Volcano mancozeb 800 WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				
457	Mancopec 80% WP	Mancozeb 800 g/kg	Carcinogen (see Annex I)				

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
466	Metacidine 40% WP	Methidathion 400 g/kg	WHO class II, but oral hazard close to Class Ib	Cotton, tobacco, sugar cane, vegetables, maize	0		EU: No (NS) USA: No; voluntary cancellation in progress
646	Mesurol Super Snail Pellets 1.5% RB	Methiocarb 5 g/kg+	WHO class II, but oral hazard close to Class Ib	Maize, groundnut, potato, vegetables, citrus	0	More concentrated formulations in HHP shortlist above.	EU: Yes USA: Yes
887	Volomyl 20% SL	Methomyl 200 g/l	WHO class II, but oral hazard close to Class Ib	Maize, groundnut, potato, vegetables, citrus, cotton, tobacco, flowers,	550 L (2012)	More concentrated formulations in HHP shortlist above.	EU: Yes USA: Yes
463	Rikki 20% SL	Methomyl 200 g/l	WHO class II, but oral hazard close to Class Ib				
1105	Volxyl 24% EC	Oxyfluorfen 240 g/l	Carcinogen (see Annex I)	Cotton, soybean, groundnut, vegetables, citrus, pine trees, eucalyptus trees	900 L (2010) 1200 L (2012)		EU: Yes USA: Yes
1131	King Insectos Voadores	Permethrin 0,4 g/kg (+d-Allethrin 0,82 g/kg +piperonyl butoxide 3,3 g/kg)	Carcinogen (see Annex I)	Stored grain, public health and domestic use	4958 L (2010) 27820 L (2011) 5000 L (2013)		EU: No (E) USA: Yes
974	Majestic Ultra 50% EC	Permethrin 100 g/l (+pirimiphos methyl 400 g/l)	Carcinogen (see Annex I)				
967	Cooper Aerosol Fly and Mosquito Killer	Permethrin 15 g/kg (+piperonyl butoxide 15 g/kg)	Carcinogen (see Annex I)				
1132	King Insectos Rastejantes	Permethrin 2,5 g/kg (+pyrethrins 1 g/kg)	Carcinogen (see Annex I)				
1123	Majestic super 2% DP	Permethrin 3 g/kg (+pirimiphos methyl 16 g/k)	Carcinogen (see Annex I)				
629	Super Guard Dust 2% DP	Permethrin 4 g/kg (+pirimiphos methyl 16 g/kg)	Carcinogen (see Annex I)				

Reg. no.	Trade name	Active ingredient (a.i.)	Reason for identification as potential HHP	Registered uses in Mozambique (summary)	Import volumes (2010 – 2013)	Notes	Registration status of a.i. elsewhere[1]
163	Larvin 37,5% SC	Thiodicarb 375 g/l	WHO class II, but very close to Class Ib	Cotton	0		EU: No (H & E) USA: Yes
Total	***[54]***	***[16]*** *(of which 3 a.i.'s already listed in HHP shortlist above)*					

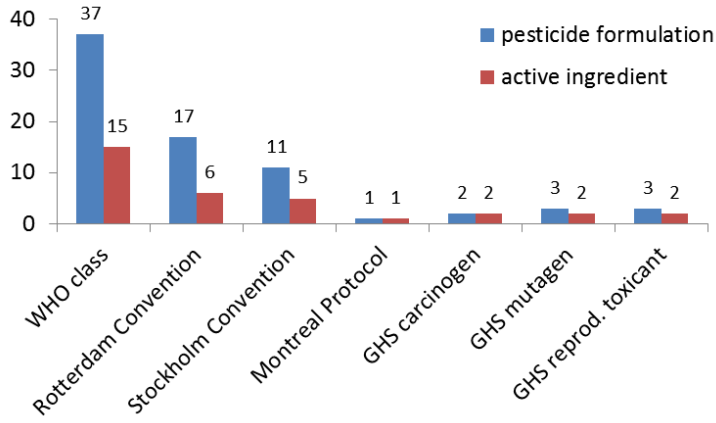

Figure 4. The number of identified highly hazardous pesticides (HHPs) in Mozambique according to the various JMPM criteria. Note that a pesticide may be identified as HHP based on more than one criterion.

3.3 Identification of pesticides "coming close" to HHPs

Using the criteria listed in Section 2.1, 54 formulated pesticide products containing 16 different active ingredients were identified as "coming close" to being an HHP (Figure 3 and Table 6). Of the 16 active ingredients, 13 were not listed under the HHPs.

Pesticide products were most often classified as being "close to" HHPs based on the acute oral or dermal toxicity of the formulations. In addition, the carcinogenicity evaluations of 16 active ingredients did not result in similar conclusions between the EU and the US-EPA. Generally, these pesticides which were evaluated as likely or probable carcinogens by the US-EPA, but not by the EU. Seven of the 16 active ingredients were considered a sufficiently great concern for Mozambique to include them under the group of pesticides "coming close" to HHPs (see Annex 1 for the justification).

In the case of paraquat, the WHO Classification notes in addition that it "*has serious delayed effects if absorbed. It is of relatively low hazard in normal use but may be fatal if the concentrated product is taken by mouth or spread on the skin*" (WHO, 2010). The occupational hazard of paraquat is confirmed by the very low Acceptable Operator Exposure Level defined in the EU (PPDB, 2012).

3.4 Registrations elsewhere

In national decision making on the continuation or modification of the registration of a HHP, it may be useful to review how other, reputable, registration authorities have evaluated the pesticide and what final registration decision they have taken.

In this step of the project, a quick search was conducted of the registration status in the EU and the USA of all pesticides listed in Table 6. This shows that some pesticides listed as HHP in Mozambique are not registered, or are being phased out, in both the EU and the USA (i.e. 9 active ingredients of HHPs and 3 additional ones for the "close to" HHPs). In some cases, this was for health and/or environmental reasons, but in others because the registration dossier was incomplete or because the pesticide was never submitted for registration in the first place. The

majority of the pesticides listed in Table 6, however, is still registered in either the EU or the USA, or in both.

When deciding on risk reduction measures for HHPs in Mozambique, including possible phase-out of certain products, it is therefore important to evaluate why exactly other registration authorities have decided not to register a pesticide; or if they have registered the pesticide, under which conditions it is allowed. These justifications and conditions should then be compared to the – actual or expected – use situation in Mozambique to evaluate whether the pesticide can continue to be used in the country, and with what possible restrictions.

3.5 Import statistics

The volumes of pesticides identified as HHPs and "coming close" to HHPs that were imported into Mozambique in the period 2010 – mid-2012 are listed in Table 6. The main objective of reviewing the import statistics is to identify which pesticides are likely not used (anymore) in the country, and for which no use surveys or additional hazard/risk assessments (Project Step 2) need to be conducted.

For 21 out of the listed 38 HHP-and "close to" HHPs active ingredients, no pesticide products were imported at all. For another seven active ingredients, less than 250 kg or litres were imported annually, and these would have a relatively low priority for further use surveys.

The most imported HHPs are products containing aluminium phosphide, benomyl, dichlorvos, difethialone, endosulfan, formaldehyde and metamidophos, with average annual imports greater than 2000 kg or litres; the most imported pesticides "coming close" to HHPs are 2,4-D dimethylamine, bendiocarb, diuron, mancozeb, paraquat and permethrin.

4 Conclusion

4.1 Methodology

The approach used for this first step of the project was entirely desk-based. It consisted of comparing all pesticide products registered in Mozambique against the criteria for highly hazardous pesticides (HHPs) as defined by the FAO/WHO Joint Meeting on Pesticide Management (JMPM). Since no international databases exist of HHPs, various reputable data sources were used to verify the criteria for each registered pesticide.

Overall, this approach allowed the assessment of the large majority of pesticide products registered in Mozambique. Some data gaps were identified, however, mainly for microbial pesticides, adjuvants/synergists and repellents. These pesticides could not be evaluated against all HHP criteria. But because these groups are generally of low hazard, it is not very likely that HHPs would have been missed.

On the other hand, a limited number of "regular" chemical pesticides could not be evaluated either for some criteria, using the data sources chosen for this study. Data were lacking mainly with respect to chronic toxicity (carcinogenicity, mutagenicity and reproductive toxicity) and for characteristics to identify persistent organic pollutants (POPs). Therefore, it cannot be excluded that the list of HHPs would be slightly longer if data would have been available for all pesticides.

The assessment of import volumes is very useful to distinguish between pesticides which have been registered but are not used in Mozambique, and those that are. This greatly helps to reduce the short-list of HHPs which require further use and exposure surveys and/or hazard/risk assessments.

4.2 Short-list of HHPs

The main objective of this first step of the project was to identify highly hazardous pesticides (HHPs) that are registered and used in Mozambique, and prepare a short-list of products that require further surveys on use and exposure and/or risk assessments. It is on the basis of the combined information from theoretical hazard assessments, more realistic risk assessments and actual use and exposure information that the Ministry of Agriculture can make informed decisions on further authorization of use of these HHPs.

This first step therefore results in a short-list on which to focus activities under Step 2 of the project. Based on the evaluation of HHP criteria discussed above, and the import statistics, it is recommended to focus the use and exposure surveys in the field, and further hazard and risk assessments, on the pesticide products listed in Table 7. These are all pesticides which average annual imports of more than approximately 250 kg or L. Identified HHPs that are imported in lower volumes are not given priority for Step 2 activities.

In total, Table 7 consists of 76 pesticide products containing 18 different active ingredients. These represent 10% of registered pesticide products and 8% of registered active ingredients in Mozambique.

Table 7. Short-list of highly hazardous pesticides (HHPs) and pesticides "coming close" to HHPs, prioritized for further study in Step 2 of the project.

Reg. no.	Trade name	Active ingredient
HHPs		
1172	Fumate 56% FT	Aluminium Phosphide 560 g/kg
1054	Moz Aluminium Phosphide Pellets	Aluminium Phosphide 560 g/kg
581	Phosgard 56% FT	Aluminium phosphide 560 g/kg
773	Falfume 57% FT	Aluminium Phosphide 570 g/kg
1071	Moz Aluminium Phosphide Tablets	Aluminium Phosphide 570 g/kg
1129	Quickphos 57% FT	Aluminium Phosphide 570 g/kg
1080	Biophos 57% FW	Aluminium phosphide 570 g/kg
1028	Celphos 57% FT	Aluminium phosphide 570 g/kg
664	Volcano Aluminium Phosphide 57% FT	Aluminium phosphide 570 g/kg
467	Benopec 50% WP	Benomyl 500 g/kg
772	Volcano Demeter 50% WP	Benomyl 500 g/kg
1202	Divos 100% EC	Dichlorvos 1000 g/l
774	Falcovos 100% EC	Dichlorvos 1000 g/l
984	Nuvam 100% EC	Dichlorvos 1000 g/l
944	Finale Rat And Mouse Grain Bait	Difethialone 0,025 g/kg
969	Finale Rat And Mouse Pellets	Difethialone 0,025 g/kg
943	Finale Rat And Mouse Wax Bait	Difethialone 0,025 g/kg
719	Ratex Pellts	Difethialone 0,025 g/kg
1027	Endocel 35% EC	Endosulfan 350 g/l
447	Endopec 35% EC	Endosulfan 350 g/l
825	Enticer 35% EC	Endosulfan 350 g/l
605	Volcano Endosulfão 35% EC	Endosulfan 350 g/l
1115	Vet Fume B	Formaldehyde 370 g/l
1163	Chemaron 58% SL	Methamidophos 585 g/l
1199	Sniper 58.5% SL	Methamidophos 585 g/l
639	Volmet 58,5% SL	Methamidophos 585 g/l
1198	Methomex 90% SP	Methomyl 900 g/kg
1185	Oxadate 31% SL	Oxamyl 310 g/l
810	Vydate 31% SL	Oxamyl 310 g/l
"close to" HHPs		
570	Volcano 2,4 D 72% SL	2,4-D dimethylamine 720 g/l
1063	Moz Paraquat 20% SL	Paraquat 200 g/l
1303	Paracot 20% SL	Paraquat 200 g/l
1262	Para-Cure 20% SL	Paraquat 200 g/l
458	Paraxone 20% SL	Paraquat 200 g/l
764	Volquato 20% SL	Paraquat 200 g/l
1181	Gramozat 20% SL	Paraquat 200 g7l

Reg. no.	Trade name	Active ingredient
544	Ficam 80% WP	Bendiocarb 800 g/kg
735	Tocaia 80% WP	Bendiocarb 800 g/kg
884	Avisnail 5% RB	Carbaryl 20 g/kg (+metaldehyde 30 g/kg
811	Supona 30% EC	Chlorfenvinphos 300 g/l
1155	Dichlorvos 10% EC	Dichlorvos (DDVP)100 g/l
985	Nuvan Profi 12,4% AE	Dichlorvos 124 g/l
986	Metrad 75% WG	Diuron 400 g/kg (+metribuzin 360 g/kg)
461	Dipec 80% WP	Diuron 800 g/kg
849	Volcano Diuron 80% WG	Diuron 800 g/kg
532	Volcano Diurão 800 SC	Diuron 800 g/l
1061	Moz Diuron 80% SC	Diuron 800 g/l
1101	Milthane Super 80% WP	Mancozeb 800 g/kg
663	Volcano Crater MX 70% WP	Mancozeb 100 g/kg (+metalaxyl 600 g/kg)
508	Etylit MZ 70% WP	Mancozeb 350 g/kg (+fosetyl-aluminium 350 g/kg)
1236	Crater 455 SC	Mancozeb 455 g/l
477	Megatop 50,5% WP	Mancozeb 465 g/kg (+cymoxanil 40 g/kg)
1075	Dithane NT 60% OS	Mancozeb 600 g/kg
875	Volcano Crater MX 72% WP	Mancozeb 640 g/kg (+ Metalaxyl 80 g/kg)
546	Ridomil Gold 68% WP	Mancozeb 640 g/kg (+metalaxyl 40 g/kg)
472	Ekyp MZ 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)
823	Mascot 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)
1136	Metaman FAE PM 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)
1087	Neltylxyl 72% WP	Mancozeb 640 g/kg (+metalaxyl 80 g/kg)
844	Ridomil Gold MZ 68 WG	Mancozeb 640 g/kg (+metalaxyl-M 40 g/kg)
1045	Moz Controller	Mancozeb 700 g/kg (+cymoxanil 60 g/kg)
1307	Cotzeb 80% WP	Mancozeb 800 g/kg
1162	Curethane 80% WP	Mancozeb 800 g/kg
1078	Dithane NT 80% WP	Mancozeb 800 g/kg
1143	Mazole 80% WP	Mancozeb 800 g/kg
1133	Policar MZ 80% WP	Mancozeb 800 g/kg
1221	Ventum 80% WP	Mancozeb 800 g/kg
887	Volomyl 20% SL	Methomyl 200 g/l
463	Rikki 20% SL	Methomyl 200 g/l
1105	Volxyl 24% EC	Oxyfluorfen 240 g/l
1131	King Insectos Voadores	Permethrin 0,4 g/kg (+d-Allethrin 0,82 g/kg +piperonyl butoxide 3,3 g/kg)
974	Majestic Ultra 50% EC	Permethrin 100 g/l (+pirimiphos methyl 400 g/l)
967	Cooper Aerosol Fly and Mosquito Killer	Permethrin 15 g/kg (+piperonyl butoxide 15 g/kg)

Reg. no.	Trade name	Active ingredient
1132	King Insectos Rastejantes	Permethrin 2,5 g/kg (+pyrethrins 1 g/kg)
1123	Majestic super 2% DP	Permethrin 3 g/kg (+pirimiphos methyl 16 g/k)
629	Super Guard Dust 2% DP	Permethrin 4 g/kg (+pirimiphos methyl 16 g/kg)

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Annex 1: Carcinogenicity – ambiguous cases

This annex lists the pesticides for which the carcinogenicity evaluations by WHO/IARC, EPA and the EU did not result in the same outcome. The final conclusion for the HHP assessment in Mozambique is in the last column of the table. Those considered a carcinogen equivalent to GHS class 1A and 1B are listed as "Yes" and included under the section *Registered pesticides not complying with the JMPM criteria, but "coming close"* of Table 6 of this report.

Active ingredient	**Reviews: carcinogenic** (similar to GHS 1A&1B) **yes/no?** [date of publication of review]				**Conclusion for HHP identification.** **Carcinogenic** (similar to GHS 1A&1B) **yes/no?**
	IARC	**EPA carcinogenicity list**	**EU**	**WHO Classification**	
Alachlor	Not evaluated	Yes: likely at high doses; not likely at low doses; [June 1997] Note: US registered	No; unlikely at doses attained in use (Carc[9]. = Cat. 2) [Jan 2007] Note: EU not registered	No – carcinogenicity mechanism not relevant to humans [2010]	No. US registered, and EU not registered. Most recent reviews conclude pesticide is not carcinogenic at relevant rates
Carbaryl	No [1987]	Yes: likely to be carcinogenic [Feb 2002] Note: US registered, but basic or extensive PPE required for handling and use ; wettable powders only packaged in water-soluble bags, to reduce cancer risk (amended RED[10], 2008)	No (Carc. = Cat. 2) [Sep 2006] Note: EU not registered; potential carcinogenic properties of the active substance is noted as a concern (Review report[11], 2006)	Not evaluated	Yes. EU not registered. US registered, but with PPE other risk mitigations

[9] Carc.: Carcinogenicity classification (EU)

[10] RED: Reregistration Eligibility Document (US – Environmental Protection Agency)

[11] Review report: Review report on active substances (EU - Standing Committee on the Food Chain and Animal Health)

Active ingredient	**Reviews: carcinogenic** (similar to GHS 1A&1B) **yes/no?** [date of publication of review]				**Conclusion for HHP identification.** **Carcinogenic** (similar to GHS 1A&1B) **yes/no?**
	IARC	**EPA carcinogenicity list**	**EU**	**WHO Classification**	
Chlorothalonil	Not evaluated	Yes: likely to be carcinogenic [Oct 1997] Note: US registered. Dietary cancer risk due to HCB impurities in chlorothalonil; limit < 40 ppm is acceptable. (RED Factsheet[12] 1999)	No (Carc. = Cat. 2) [Sep 2006] Note: EU registered	Not evaluated	No; unless products in Mozambique contain high levels of HCB impurities Registered in both US and EU.
Diuron	Not evaluated	Yes: known/likely to be carcinogenic [July 1997] Note: US registered. However, occupational cancer risk of concern; i.e. use of backpack sprayers prohibited (RED, 2003)	No (Carc. = Cat. 2) [Jul. 2008] Note: EU registered	Not evaluated	Yes Explicit prohibition of use with backpack sprayers in US; so a concern for Mozambique
Epoxicionazol	Not evaluated	Yes: likely to be carcinogenic [Jan 2001] Note: US only an import tolerance; dietary risk acceptable; occupational risk not evaluated	No (Carc. = Cat. 2) [sep 2010] Note: EU registered	Not evaluated	No Registered in EU and tolerance in US.

[12] Factsheet: US – EPA pesticide registration factsheets

Active ingredient	**Reviews: carcinogenic** (similar to GHS 1A&1B) **yes/no?** [date of publication of review]				**Conclusion for HHP identification.** **Carcinogenic** (similar to GHS 1A&1B) **yes/no?**
	IARC	**EPA carcinogenicity list**	**EU**	**WHO Classification**	
Iprodione	Not evaluated	Yes: likely to be carcinogenic [Feb 1998] Note: US registered. However, all residential uses cancelled due to cancer risk concerns. Also, backpack sprayers, mixers should wear double layer PPE, masks and gloves. (RED, 1998)	No (Carc. = Cat. 2) [sep 2004] Note: EU registered	Not evaluated	Yes Registered in both EU and US. However, US proposed risk mitigation measures (PPE for sprayers/handlers and cancellation of residential uses) poses significant concern for Mozambican use situation.
Isoxaflutole	Not evaluated	Yes: likely to be carcinogenic [Sep 1997] Note: US registered.	No (Carc. not classified) [oct 2003] Note: EU registered	Not evaluated	No. Registered in both EU and US.
Kresoxim-methyl	Not evaluated	Yes: likely to be carcinogenic [Aug 1999] Note: US registered. But only on ornamental crops (Factsheet 1998)	No (Carc. = Cat. 2) [jan 2012] Note: EU registered	Not evaluated	No. Registered in both EU and US.
Mancozeb (cancer risk due to ETU metabolite)	Not evaluated	Yes: probable human carcinogen [Jul 1999] Note: US registered. Cancer risk below EPA thresholds; but (at least) layer PPE required; WP formulations only as water-soluble bags (RED 2005)	No (Carc. not classified) [july 2006] Note: EU registered	Not evaluated	Yes. Registered in both EU and US. However, US proposed risk mitigation measures (full PPE for sprayers/handlers and requirement for water-soluble bags for WPs) poses significant concern for Mozambican use situation.

Active ingredient	**Reviews: carcinogenic** (similar to GHS 1A&1B) **yes/no?** [date of publication of review]				**Conclusion for HHP identification.** **Carcinogenic** (similar to GHS 1A&1B) **yes/no?**
	IARC	**EPA carcinogenicity list**	**EU**	**WHO Classification**	
Metiram	Not evaluated	Yes: probable human carcinogen [Jul 1999] Note: US registered. (RED, 2005)	No (Carc. not classified) [july 2006] Note: EU registered (review report 2005: "no evidence of carcinogenic potential")	Not evaluated	No. Registered in both EU and US. Most recent EU review concludes pesticide is not carcinogenic
Oxadiazon	Not evaluated	Yes: likely to be carcinogenic [May 2001] Note: US registered. Cancer risks for occupational handlers of wettable-powder formulations of oxadiazon are of concern. Exposure scenarios of concern include mixing/ loading/ applying wettable powder formulations. To reduce these risks, the wettable powder formulations will be packaged in water-soluble packaging (WSP) only (RED Factsheet 2008)	No Carc. not classified. [jan 2010] Note: EU registered EFSA Conclusion (2010): "humans are not responsive to this class of non-genotoxic carcinogens and therefore, oxadiazon is unlikely to present a carcinogenic risk to humans"	Not evaluated	No. Registered in both EU and US. Most recent review indicates low cancer risk.
Oxyfluorfen	Not evaluated	Yes: likely to be carcinogenic [Mar 2010] Note: US registered. Cancer risk of handlers applicators / workers: Double layer Personal Protective Equipment (PPE) for all other mixers, loaders, and applicators; closed mixing/loading/ application systems required for use in several major crops.	No (Carc. not classified) [jan 2012] Note: EU registered EFSA Conclusion (2010): … classification as Carc Cat 3 – *limited evidence of a carcinogenic effect* – was proposed by EFSA.	Not evaluated	Yes. Registered in both EU and US. However, US proposed risk mitigation measures (double PPE and closed systems) poses significant concern for Mozambican use situation.

Active ingredient	**Reviews: carcinogenic** (similar to GHS 1A&1B) **yes/no?** [date of publication of review]				**Conclusion for HHP identification.** **Carcinogenic** (similar to GHS 1A&1B) **yes/no?**
	IARC	**EPA carcinogenicity list**	**EU**	**WHO Classification**	
Permethrin	No [1991]	Yes: likely to be carcinogenic [Oct 2002] Note: US registered. In some application scenarios, cancer risk exceeds the threshold. WP and DP formulations require double layer PPE. (Factsheet, 2009).	No (Carc. not classified) Note: EU not registered. (due to incomplete dossiers, mainly for ecotox topics).	Not evaluated	Yes. Registered in US, but not in EU. Certain uses in US require extensive PPE – to be compared with Mozambique uses of permethrin.
Tetrachlorvinphos	No	Yes: likely to be carcinogenic [Mar 2002] No: Group C: possible human carcinogen [July 2006] Note: US registered.	No (no classification because no toxicological information) Note: EU not registered.	Not evaluated	No. Latest US evaluation does not place this pesticide in the HHP category
Thiabendazole	Not evaluated	Yes: Likely human carcinogen at high doses; not likely at low doses [Mar 2002] Note: US registered. "Carcinogenic risks at expected doses not pose a concern" (Factsheet, 2002)	No (Carc. not classified) Note: EU registered.	Not evaluated	No. Registered in both EU and US.
Thiodicarb (Note: rapid degradation to methomyl)	Not evaluated	Yes: Probable human carcinogen. [Jun 1996] Note: US registered. Relatively standard PPE requirements; no specific PPE to reduce carcinogenicity risk (RED, 1998)	No (Carc. not classified) Note: EU not registered. Overall, thiodicarb does not show genotoxic or carcinogenic potential (EFSA Opinion, 2005)	Not evaluated	No. Most recent EU review concludes pesticide is not carcinogenic

Reducing Risks of Highly Hazardous Pesticides in Mozambique

Step 2 – Survey of pesticide use practices in selected cropping systems

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[9 July 2014]

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FAO Disclaimer

Contents

1. Introduction

A project entitled *Reducing Risks of Highly Hazardous Pesticides (HHPs) in Mozambique* was initiated by the Government of Mozambique with the objective to reduce the greatest risks associated with pesticide use in the country. This project is implemented with technical support of FAO's Pesticides Management Unit and is funded by SAICM Quick Start Programme Trust Fund.

The ultimate goal is to develop and implement an "HHP Risk Reduction Action Plan" for the most dangerous pesticides and use situations, resulting over time in the implementation of a variety of risk reduction measures based on a review of use conditions. These may include the cancellation of specific registrations of HHPs, implementation of risk mitigation measures, appropriate use restrictions, development of alternative pest management strategies, promotion of good agricultural practices, or phase-out of specific pesticides.

In the first step of the project, a review of all pesticides registered in Mozambique was carried out and a shortlist of highly hazardous pesticides was established. This shortlist was based on an assessment of the hazards of the pesticides, based on criteria established by the FAO/WHO Joint Meeting on Pesticide Management (Come & Van der Valk, 2014).

During the second step of the project, a use survey was carried out in selected regions and cropping systems in Mozambique. The main goal of the survey was to identify the conditions under which pesticides are being used in the country and their contribution to potential risks for human health and the environment.

The third step of the project consisted of a stakeholder consultation to further discuss the use and risks of highly hazardous pesticides in Mozambique and fine-tune the shortlist based on the survey results and the expertise and experience of stakeholders.

2. Methodology

2.1 Cropping systems

Cropping systems were selected for the study in which pesticides are used on a regular basis and/or HHPs were known to be applied. These are vegetables, cotton and tobacco, generally managed by smaller subsistence farmers. Farmers were surveyed in eight different regions of Mozambique, which was expected to provide a broad sample of pesticide use practices in the country (Table xx). In the regions where the commodity crops cotton and tobacco are grown, limited information was also collected for other crops grown by the same farmers.

In addition, pesticide use practices were also assessed in bananas and sugar cane, both plantation crops run by larger commercial farms.

Table 1 Geographical distribution and cropping systems covered by the pesticide use survey

Region	Number of districts concerned	Crops included in the survey	Number of farmers interviewed	Survey period (2013)
Maputo Ciudade	2	Vegetables	40	1–14 February
Maputo Provincia	3	Vegetables	28	31 Jan. – 8 Feb.
Gaza	2	Vegetables	30	1–19 February
Zambésia	5	Cotton Tobacco (Other crops)	15 19 (34)	29 Jan. – 14 Feb.
Tete	8	Cotton Tobacco (Other crops)	23 50 (73)	16–25 January
Nampula	4	Cotton (Other crops)	20 (20)	16 Jan. – 2 Feb.
Niassa	5	Tobacco Cotton (other crops)	25 11 (36)	17 Jan. – 1 Feb.
Cabo Delgado	4	Cotton (Other crops)	64 (64)	n.a.
Total	**33**		**325**	

Surveys were conducted in January and February 2013, during the rainy season. During this period, vegetables are grown and harvested, cotton has been sown and the plant is in early stages of development, and tobacco approaches the harvest.

2.2 Survey questionnaires

The surveys were conducted using a standard questionnaire, specific for each cropping system. The questionnaires were elaborated to obtain maximum information on pesticide use which could subsequently be used to assess the local risks of HHPs in Mozambique and evaluate the possibilities to introduce alternatives posing a lower risk. Various existing pesticide use or exposure surveys were reviewed (e.g. WHO, 2001; Amera & Abate, 2008; Rotterdam Convention, undated), as well as general guidance on development of this type of questionnaires (e.g. FAO, 1997). The first version of the questionnaire was tested among a

limited number of vegetable farmers around Maputo and various modifications were made to the final version.

The questionnaires followed a structure that was similar, though not identical, for all cropping systems:

1. Demographical socio-economic information
   - e.g.: location, sex, age, education, contact details
2. Crop information for the season 2012/2013 (vegetables, cotton, tobacco, plantation crops) and/or 2011/2012 (cotton, tobacco)
   - e.g.: type of crop, area cultivated, duration of cropping cycle
3. Pesticide application for the season 2012/2013 (vegetables, cotton, tobacco, plantation crops) and/or 2011/2012 (cotton, tobacco)
   - e.g.: name of applied pesticide(s), when applied, against which pest, application rate, number of applications per cropping cycle.
4. Pesticide product information
   - e.g.: type of formulation, type of packaging, label, where and how much purchased, costs
5. Pesticide application conditions
   - e.g.: who prepares the mixture and who applies the pesticide; source of advice on use; personal protective equipment, knowledge of label instructions; type of application equipment; management of empty containers
6. Alternative pest control methods
   - e.g.: awareness of alternative control methods; monitoring and spraying regime (for cotton)
7. Health effects
   - e.g.: if/when exposed to pesticides; decontamination; signs and symptoms of poisoning

The complete questionnaires are provided in Annex xx.

2.3 Interviewers

Interviews of farmers and pesticide distributors were performed by the plant protection officers of the Provincial Directorates of Agriculture. The interviewers were trained in a three-day session in which survey techniques and the data collection form were discussed in detail and subsequently tested in the field. Two training sessions were conducted in January 2013, in Nampula and Maputo, for five and three interviewers respectively.

2.4. Data entry and analysis

Data entry of questionnaire information was produced in Mozambique entered in excel datasets per province. The data was subsequently integrated and harmonised at FAO HQ and analysed using excel 2014.

3. Results

3.1 Socio-demographic coverage

Of the total of 325 farmer that were interviewed, 82% were male and 18% female. Most female farmers were encountered in vegetable production in Gaza and Maputo provinces (Figure xx). Only male farmers were interviewed in cotton in Tete and Zambesia provinces.

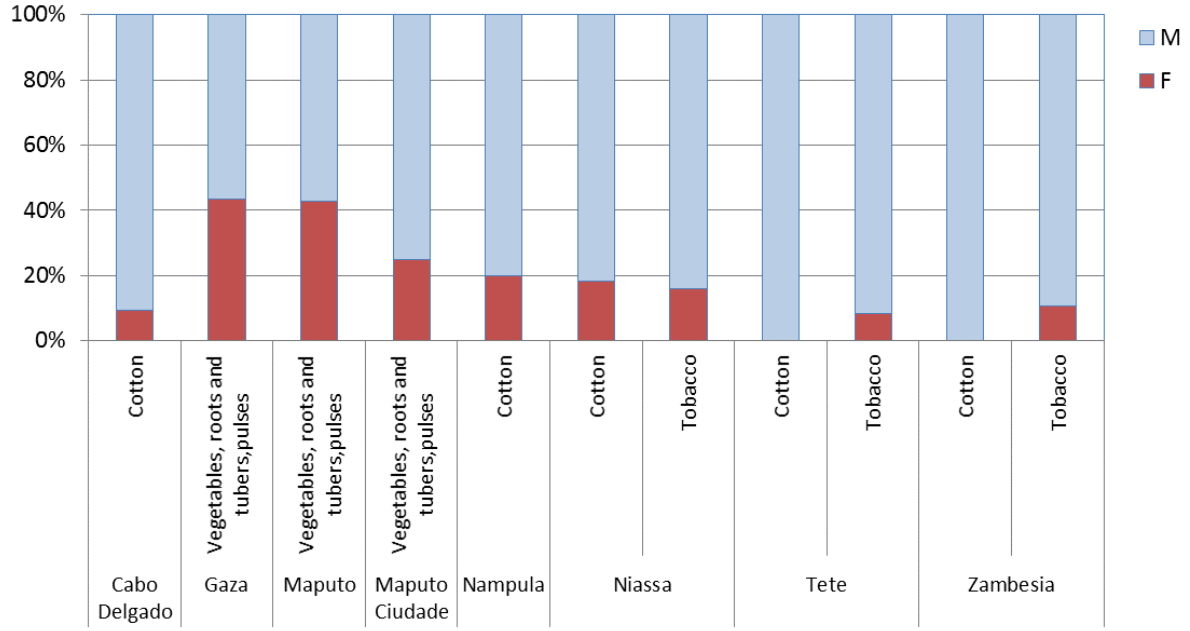


Figure 1 Gender distribution of interviewed farmers, per region and cropping system. F=female, M=male.

Overall, 68% of the interviewed farmers were between the age of 26 and 55. However, age distributions among cropping systems differed (Figure xx). Vegetable farmers were relatively older, with 60% of respondents being over 45 years of age. In contrast, cotton farmers were younger, with 35% under 35 years.

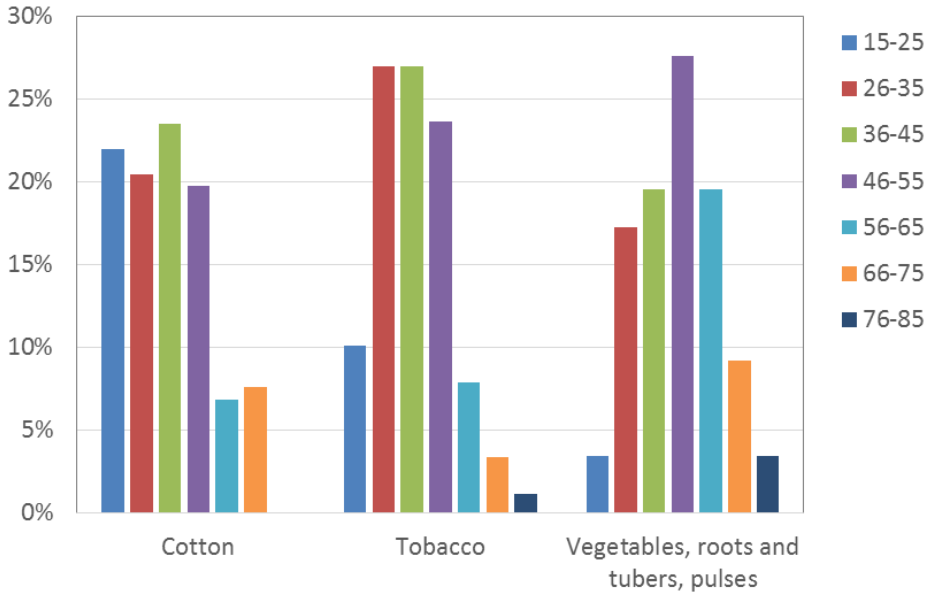


Figure 2 Gender distribution of interviewed farmers, per cropping system.

- The majority of farmers had either elementary education (33% of respondents) or had done level 5-10 (33%); 24% had no education at all. Education levels of respondents were fairly similar in Maputo, Gaza and Niassa. In Tete, Cabo Delgado and Nampula, education levels were on average slightly higher, while in Zambésia they were on average lower.

Table 2 ***Number of farmers interviewed***

Region	**Number**	**Gender**		**Education**[2]						
		Male	Female	None	Elementary	Level 5-10	Level 11-12	Basic agrarian level	Medium agrarian level	Higher level
Maputo Ciudade	40	30	10	4	21	10	2	0	0	0
Maputo Provincia	28	16	12	7	12	7	0	0	0	0
Gaza	30	17	13	4	14	9	0	0	1	1
Zambésia	34	31[1]	2	19	11	3	0	0	0	0
Tete	73	69	4	15	22	34	2	0	0	0
Nampula	20	16	4	3	5	12	0	0	0	0
Niassa	36	30	6	13	16	7	0	0	0	0
Cabo Delgado	64	58	6	14	24	24	1	1	0	0
Total	***325***	***267***	***57***	***79***	***125***	***106***	***5***	***1***	***1***	***1***

[1] One interview with a production company; gender not indicated.

2 For 7 persons education level not indicated.

3.2. Crop distribution

Table 3 crop distribution per province in database

provinces	**Cotton**	**Tobacco**	**Vegetables, roots and tubers,pulses**
Cabo Delgado	100.00%	0.00%	0.00%
Gaza	0.00%	0.00%	100.00%
Maputo	0.00%	0.00%	100.00%
Maputo Ciudade	0.00%	0.00%	100.00%
Nampula	100.00%	0.00%	0.00%
Niassa	30.56%	69.44%	0.00%
Tete	34.25%	65.75%	0.00%
Zambesia	44.12%	55.88%	0.00%
Grand Total	**41.54%**	**28.31%**	**30.15%**

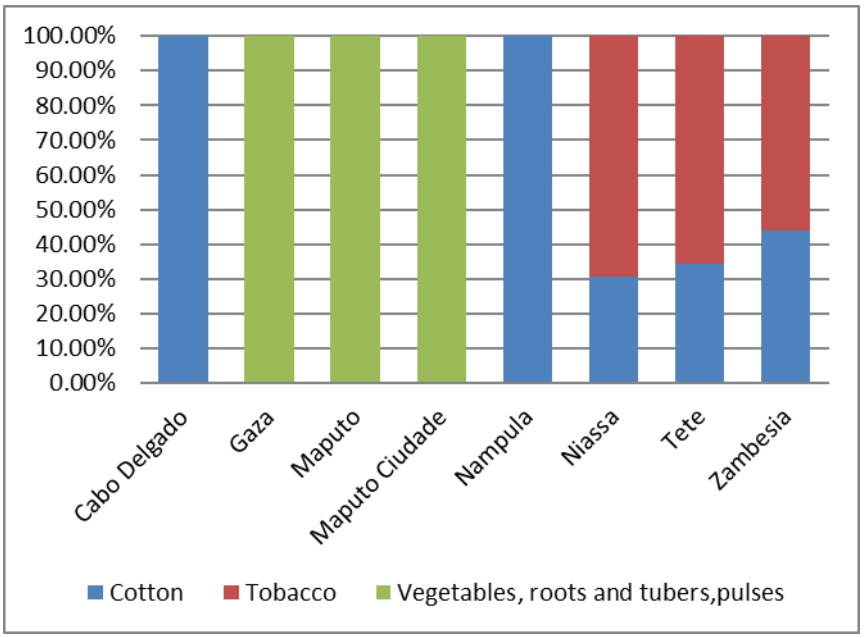


Figure 3 crop distribution per province

3.3. Use of pesticides

3.3.1. Use of pesticides

The majority of the respondents where applying themselves the pesticide, and this is true for all provinces surveyed. Therefore they were providing personal replies on their use of pesticides.
The surveys revealed that most of the farmers surveyed applied pesticides- only 17 of the 325 said they did not.

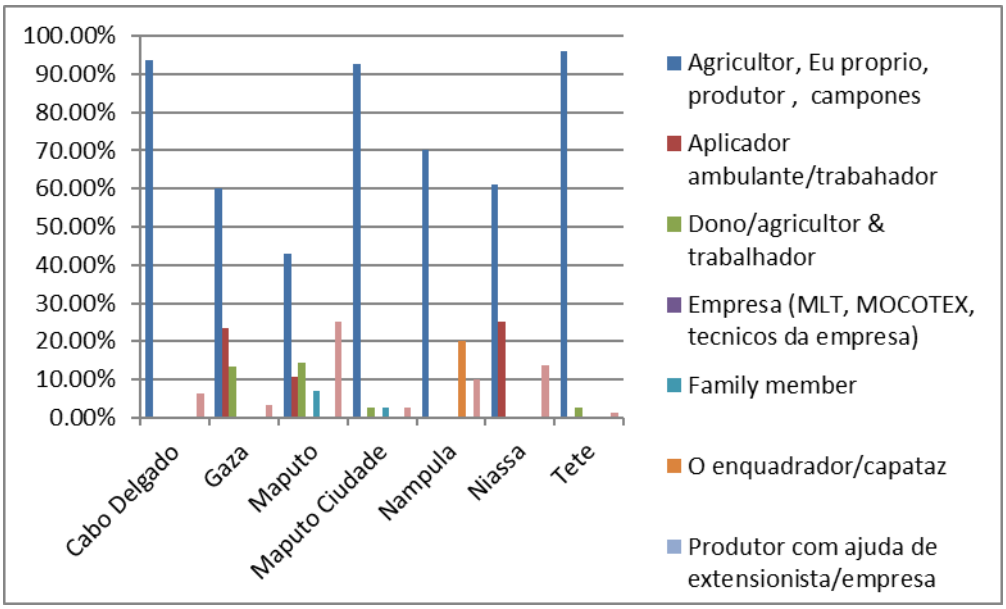


Figure 4 applicators of pesticide

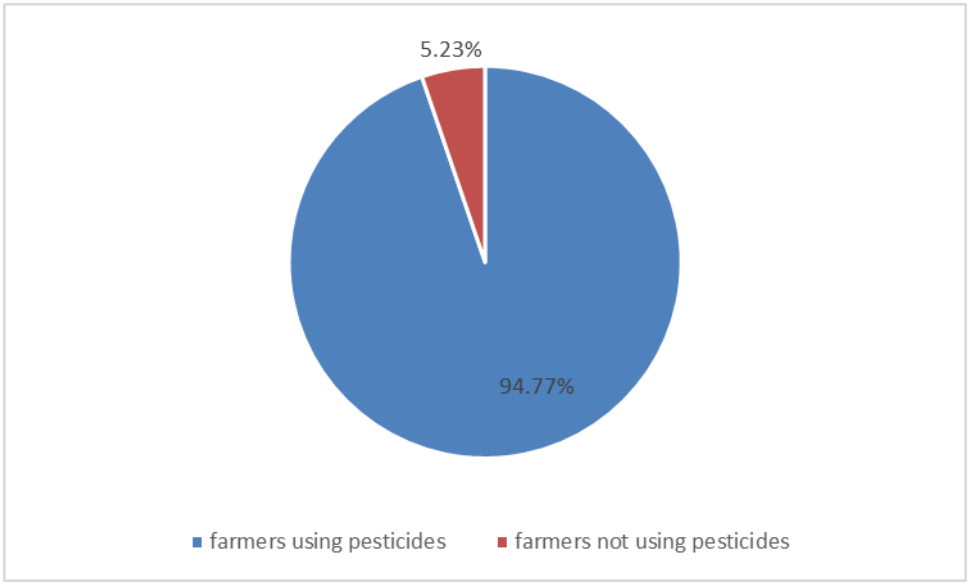


Figure 5 use of pesticide for farmer's part of the survey

3.3.2. Use of Highly Hazardous Pesticides (HHPs)

Farmers using HHPs (as per FAO-WHO 7 criteria) include almost 30% of the surveyed farmers. The HHP formulation that is most used is by far including methamidophos compound which is used by a great share of farmers particularly for vegetable crops. In addition, farmers reported overspraying vegetable crops as many as 14 timesper growing season.

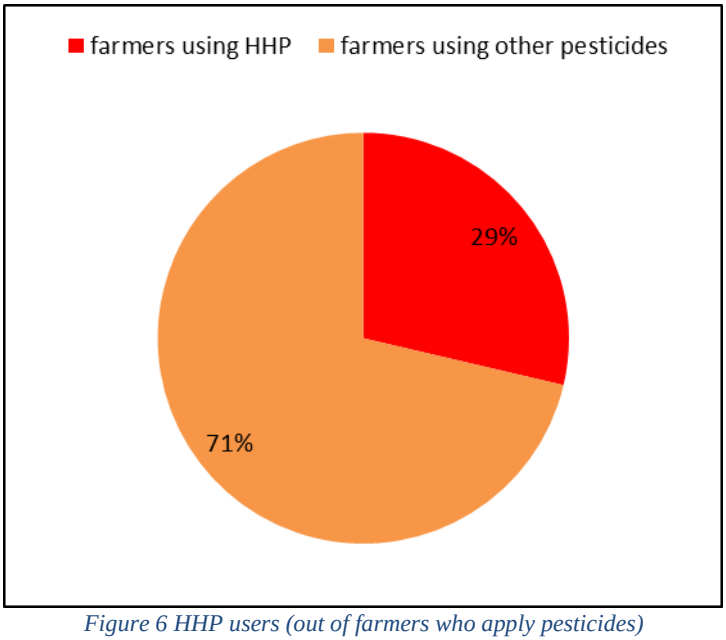


Figure 6 HHP users (out of farmers who apply pesticides)

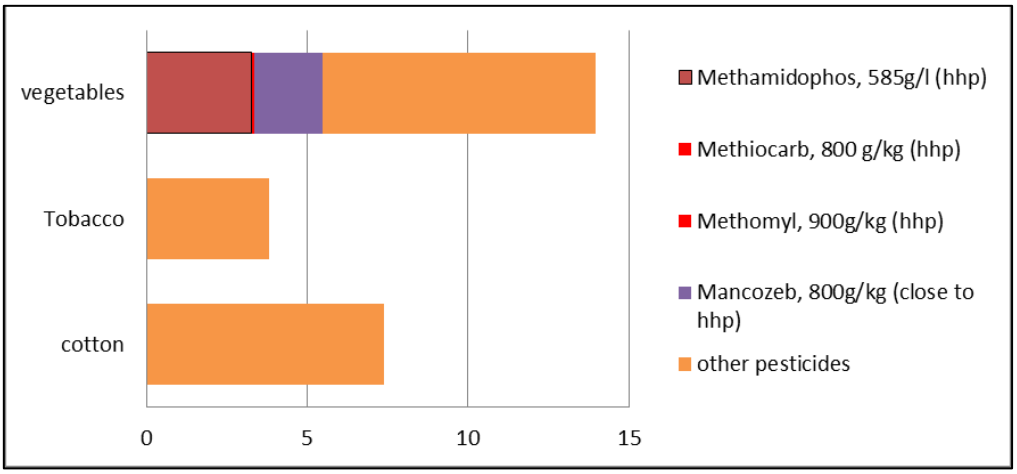


Figure 7 average applications of pesticides for farmers surveyed per crop

3.3.3. Training of farmers on pesticide use

At least half farmers did not receive training on pesticide use while making use of pesticides including HHPs.

Row Labels	Não	Sim	null	Grand Total
Cabo Delgado	60.94%	32.81%	6.25%	100.00%
Gaza	73.33%	26.67%	0.00%	100.00%
Maputo	46.43%	46.43%	7.14%	100.00%
Maputo Ciudade	55.00%	42.50%	2.50%	100.00%
Nampula	80.00%	20.00%	0.00%	100.00%
Niassa	47.22%	44.44%	8.33%	100.00%
Tete	43.84%	53.42%	2.74%	100.00%
Zambesia	5.88%	88.24%	5.88%	100.00%
Grand Total	**50.15%**	**45.54%**	**4.31%**	**100.00%**

3.3.5. Pesticide application equipment

The majority of pesticide applicators used manual sprayer (36%), followed by electric sprayer (with batteries); 33% and followed by inappropriate equipment such as watering can (13.5%) or other (unknown) means (12.5%).

Table 4 Pesticide application equipment

Provinces	Balde	Outros	Pulverizador de dorso manual	Pulverizador que funcionam a pilhas (e.x. Micro-Ulva)	Regador	no data
Cabo Delgado	0.00%	0.00%	0.00%	93.75%	0.00%	6.25%
Gaza	3.33%	0.00%	96.67%	0.00%	0.00%	0.00%
Maputo	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
Maputo Ciudade	0.00%	0.00%	97.50%	0.00%	0.00%	2.50%
Nampula	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
Niassa	0.00%	61.11%	5.56%	25.00%	0.00%	8.33%
Tete	0.00%	0.00%	24.66%	6.85%	60.27%	8.22%
Zambesia	0.00%	55.88%	2.94%	41.18%	0.00%	0.00%
Grand Total	**0.31%**	**12.62%**	**36.00%**	**33.23%**	**13.54%**	**4.31%**

3.3.6. Farmer reports of undue pesticide contamination

Farmers responses to the question: “are you receiving pesticides on clothes or skin, or in your eyes during using pesticides?” are summarised in the tables and figures below. At the national level (as sum) about half farmers surveyed reported that they noticed to receive pesticide on their clothes, bare skin or eyes when using pesticides, with some differences between provinces for different crops.

Table 5 Farmer reports of noticing of being contaminated by pesticides while using them

Provinces	Não, nunca	Sim	Sim, algumas vezes	Sim, muitas vezes	null
Cabo Delgado	20.31%	0.00%	62.50%	17.19%	0.00%
Gaza	66.67%	0.00%	23.33%	10.00%	0.00%
Maputo	28.57%	3.57%	60.71%	3.57%	3.57%
Maputo Ciudade	50.00%	17.50%	32.50%	0.00%	0.00%
Nampula	25.00%	0.00%	50.00%	25.00%	0.00%
Niassa	69.44%	0.00%	25.00%	2.78%	2.78%
Tete	63.01%	0.00%	26.03%	9.59%	1.37%
Zambesia	88.24%	0.00%	11.76%	0.00%	0.00%
Grand Total	**51.38%**	**2.46%**	**36.62%**	**8.62%**	**0.92%**

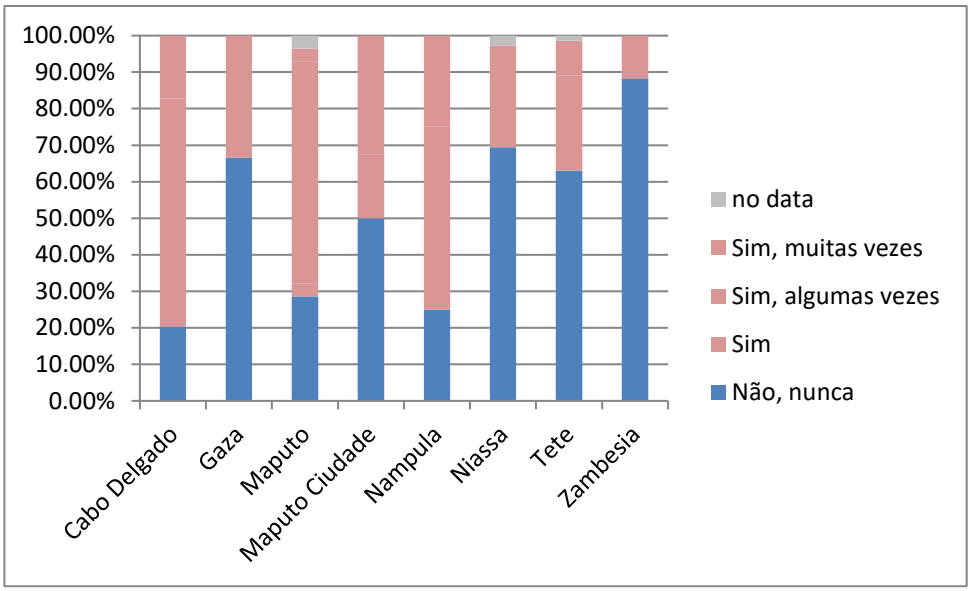
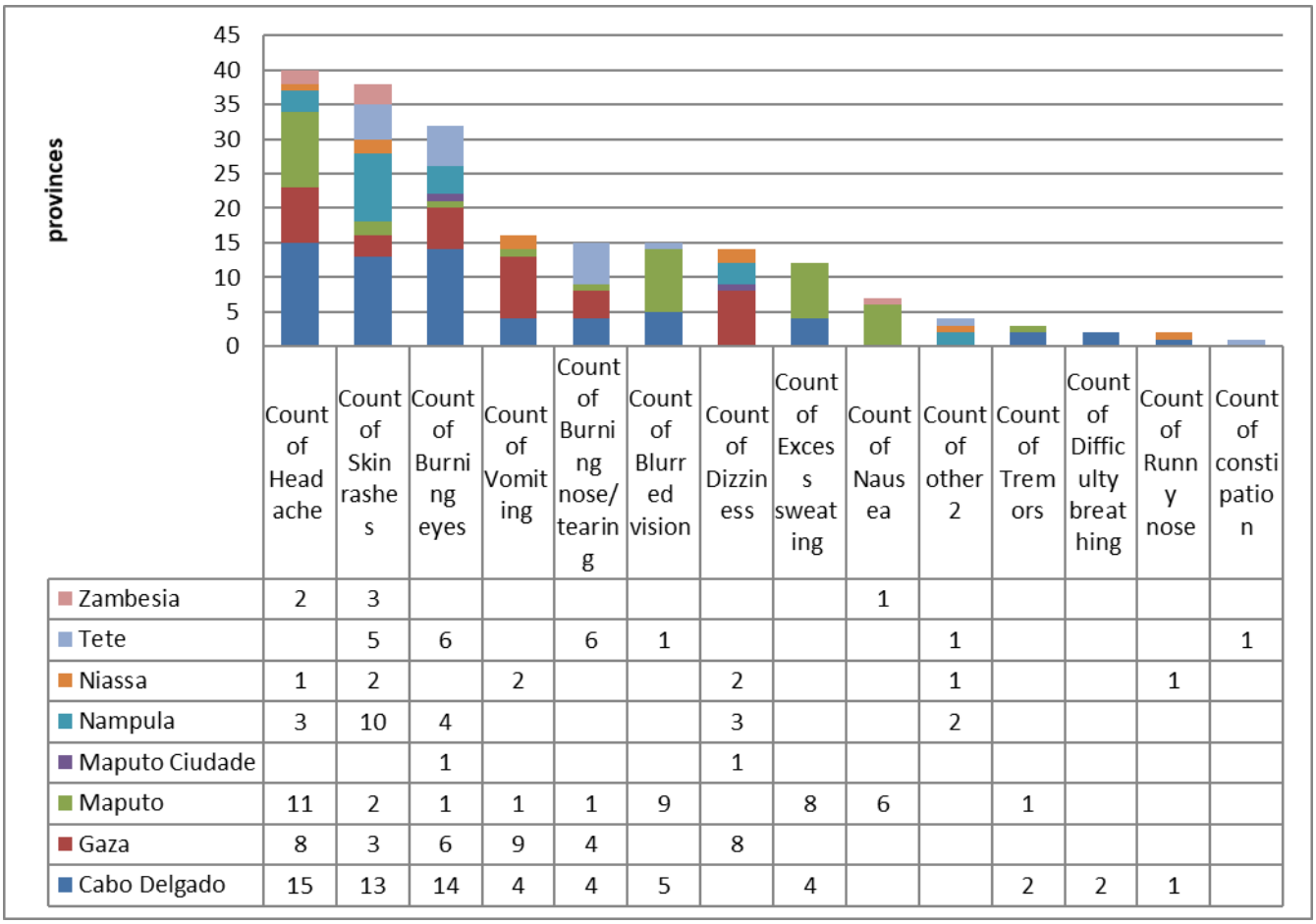


Figure 8 Farmer reports of noticing of being contaminated by pesticides while using them

3.3.7. Main health symptoms associated with pesticide use by farmers

Main health symptoms associated with pesticide use by farmers noticing symptoms were headaches, skin rashes, burning eyes, vomiting, burning nose, blurred vision, dizziness and excess sweating.



	Count of Headache	Count of Skin rashes	Count of Burning eyes	Count of Vomiting	Count of Burning nose/ tearing	Count of Blurred vision	Count of Dizziness	Count of Excess sweating	Count of Nausea	Count of other 2	Count of Tremors	Count of Difficulty breathing	Count of Runny nose	Count of constipation
Zambesia	2	3							1					
Tete		5	6		6	1				1				1
Niassa	1	2		2			2			1			1	
Nampula	3	10	4				3			2				
Maputo Ciudade			1				1							
Maputo	11	2	1	1	1	9		8	6		1			
Gaza	8	3	6	9	4		8							
Cabo Delgado	15	13	14	4	4	5		4			2	2	1	

Figure 9 Reported health symptoms of farmers per province after or during having used pesticides

3.3.8. Farmer health management of the symptoms associated with pesticide use

The great majority of farmers who noticed to experience symptoms during or right after pesticide use did not see a doctor or nurse or receive any check in a health care facility.

Table 6 health care of farmers experiencing potential symtoms of pesticide poisoning when using pesticides

Provinces	Não	Sim	null
Cabo Delgado	78.13%	1.56%	20.31%
Gaza	36.67%	0.00%	63.33%
Maputo	82.14%	3.57%	14.29%
Maputo Ciudade	45.00%	0.00%	55.00%
Nampula	85.00%	15.00%	0.00%
Niassa	83.33%	5.56%	11.11%
Tete	53.42%	0.00%	46.58%
Zambesia	91.18%	2.94%	5.88%
Grand Total	**67.38%**	**2.46%**	**30.15%**

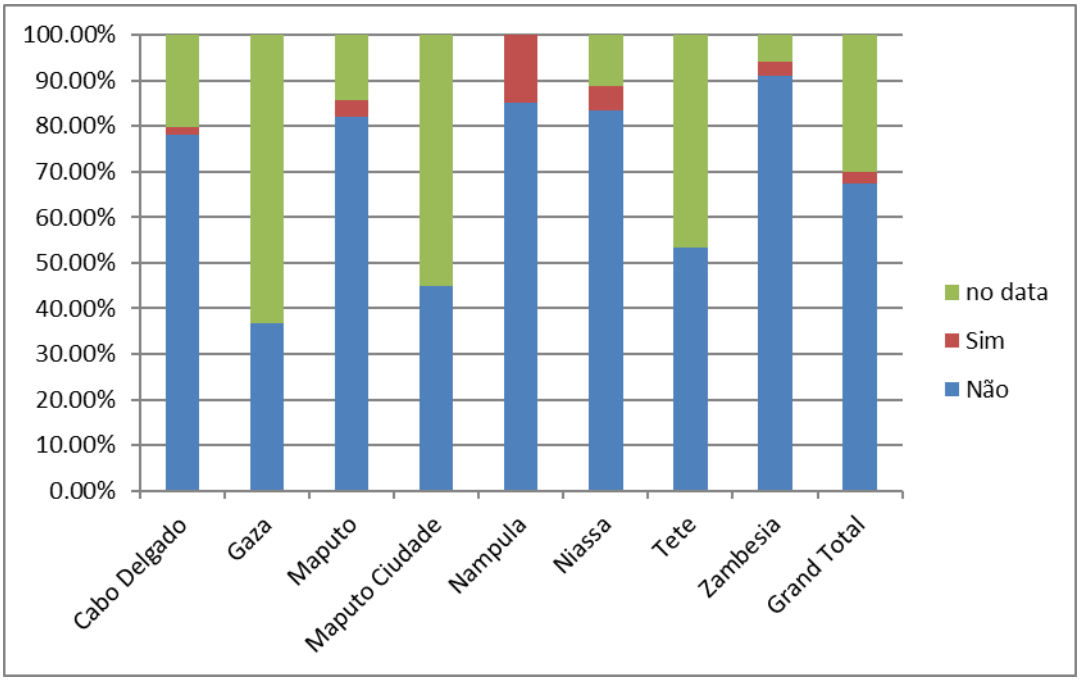


Figure 10 health care of farmers experiencing potential symtoms of pesticide poisoning when using pesticides

3.3.9. Use of Personal Protective Equipment by pesticide applicators including HHPs

Almost none of the farmers owned or wore adequate personal protective equipment. This is showns in the figures and tables below.

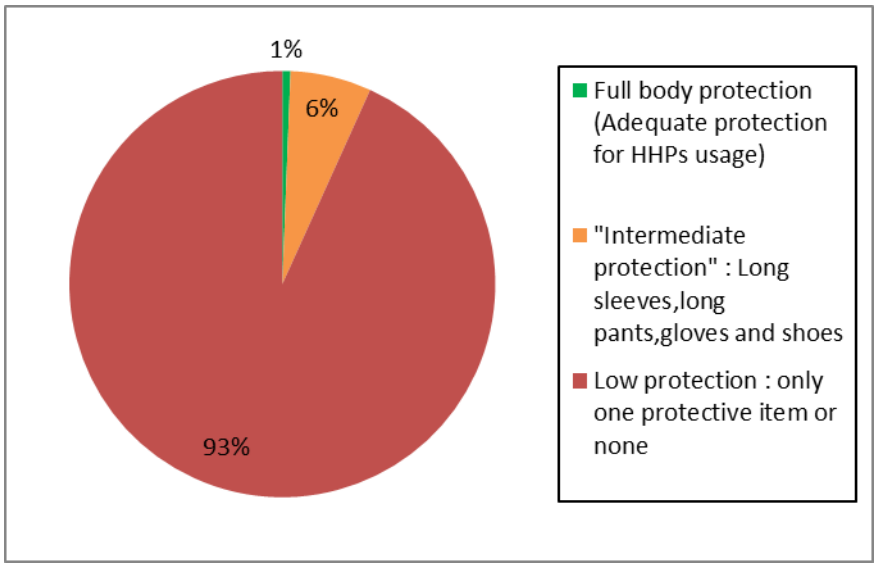


Figure 11 ***PPE usage for all farmers applying pesticides***

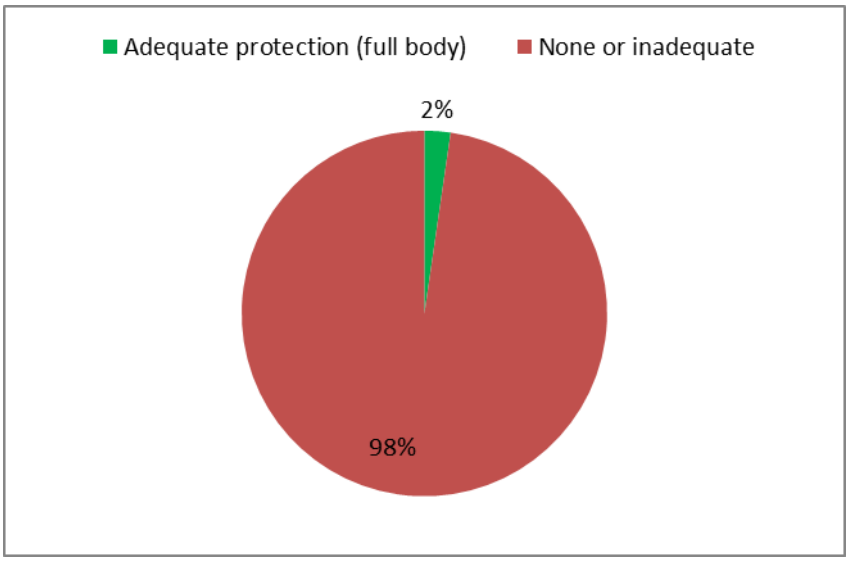


Figure 12 PPE usage for farmers applying HHPs

Table 7 Figure 14 clothes worn by pesticide applicators

Long pants	Shirt with long	Rubber boots	Gloves	bare feet or flip	T-shirt	Shorts	Shoes	Rubber mask	Overalls	Dust mask	Eyes glasses or	Other
63%	53%	39%	34%	34 %	29 %	17%	20%	15%	7%	3%	3%	2%

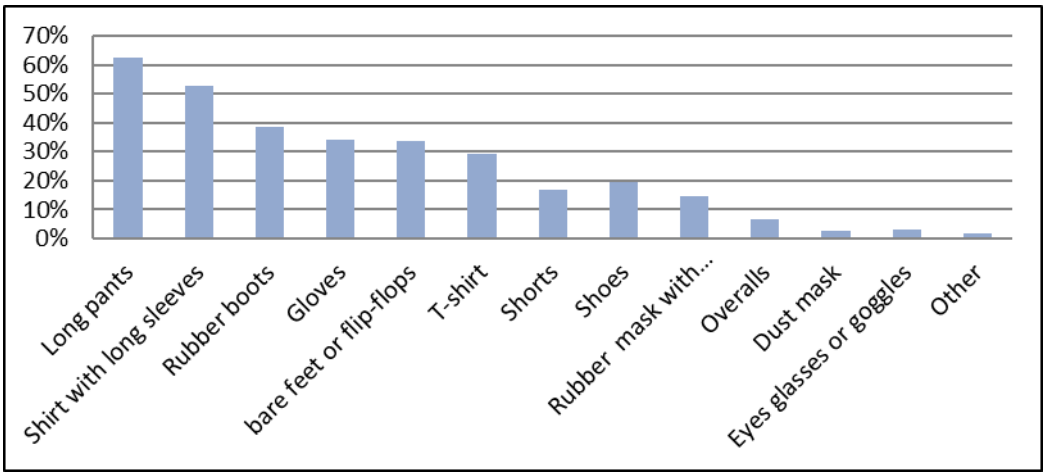


Figure 13 Clothes worn by pesticide applicators

3.3.10. Extent of protection of pesticide applicators by body part

Table 8 Protection used per body part by pesticide applicators

Row Labels	other	overalls	Rubber mask with filter	Dust mask	no mask?	Eye glasses or goggles	no eye protection?	gloves	no gloves?	t-shirt	Shirt with long sleeves	no shirt?	shorts	long pants	Rubber boots	Shoes	Bare feet
Grand Total	2	6	14	2	84	50	50	3	96	16	28	50	60	32	37	19	32

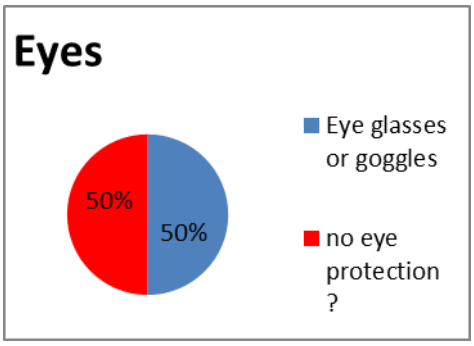


Figure 14 eye protection of pesticide applicators

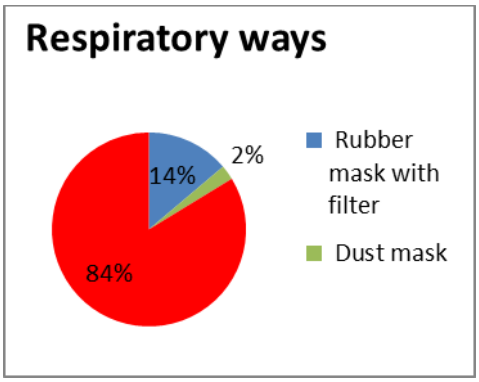


Figure 15 respiratory protection of pesticide applicators

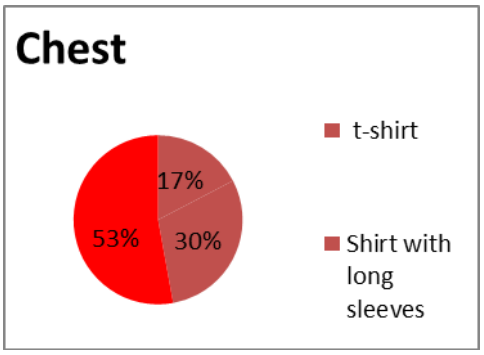


Figure 16 dermal chest protection of pesticide applicators

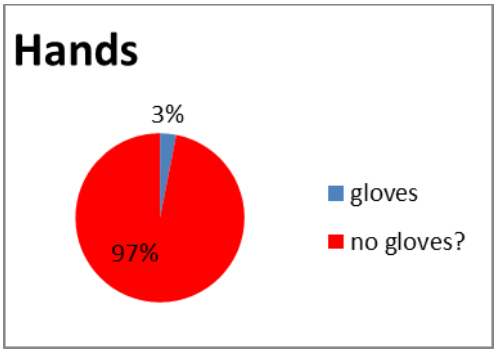


Figure 17 dermal hand protection of pesticide applicators

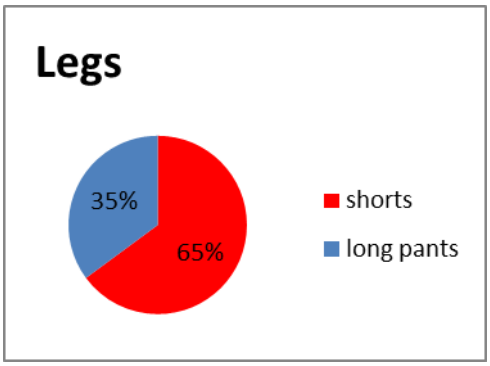


Figure 18 dermal leg protection of pesticide applicators

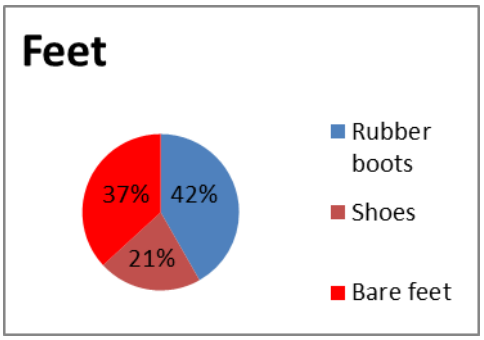


Figure 19 dermal feet protection of pesticide applicators

3.3.11. Pesticide label reading and understanding

Almost half of the farmers declared they did not read pesticide labels, includinguse instructions such as proper dosage and protective measures, the main reason being illiteracy. One out of four farmers poorly understood the colour band on pesticide labels that indicates acute toxicity. Tables and figures below show details by province and crops.

Table 9 percentage of farmers declaring to read the pesticide label per province

Provinces	Não	Sim	null	Grand Total (# of famers responding to this question	
Cabo Delgado	82.81%	10.94%	6.25%	64	
Gaza	86.67%	10.00%	3.33%	30	
Maputo	67.86%	32.14%	0.00%	28	
Maputo Ciudade	62.50%	37.50%	0.00%	40	
Nampula	95.00%	5.00%	0.00%	20	
Niassa	88.89%	5.56%	5.56%	36	
Tete	49.32%	46.58%	4.11%	73	
Zambesia	64.71%	35.29%	0.00%	34	
Grand Total	**71.38%**	**25.54%**	**3.08%**	**325**	

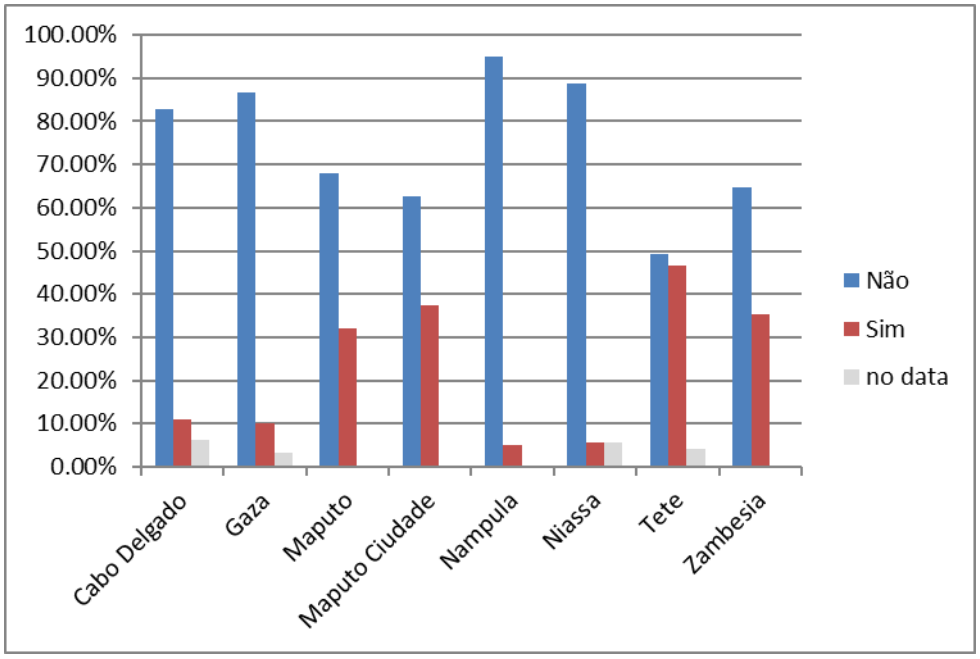


Figure 20 percentage of farmers declaring to read pesticide label per prvicince

Table 10 percentage of farmers declaring to read the label per crop and province

Row Labels	Não	Sim	null
Cotton	**41.48%**	**53.33%**	**5.19%**
Cabo Delgado	56.25%	37.50%	6.25%
Nampula	30.00%	70.00%	0.00%
Niassa	36.36%	45.45%	18.18%
Tete	28.00%	68.00%	4.00%
Zambesia	20.00%	80.00%	0.00%
Tobacco	**43.48%**	**55.43%**	**1.09%**
Niassa	56.00%	44.00%	0.00%
Tete	52.08%	45.83%	2.08%
Zambesia	5.26%	94.74%	0.00%
Vegetables, roots and tubers,pulses	**31.63%**	**66.33%**	**2.04%**
Gaza	20.00%	80.00%	0.00%
Maputo	21.43%	75.00%	3.57%
Maputo Ciudade	47.50%	50.00%	2.50%
Grand Total	**39.08%**	**57.85%**	**3.08%**

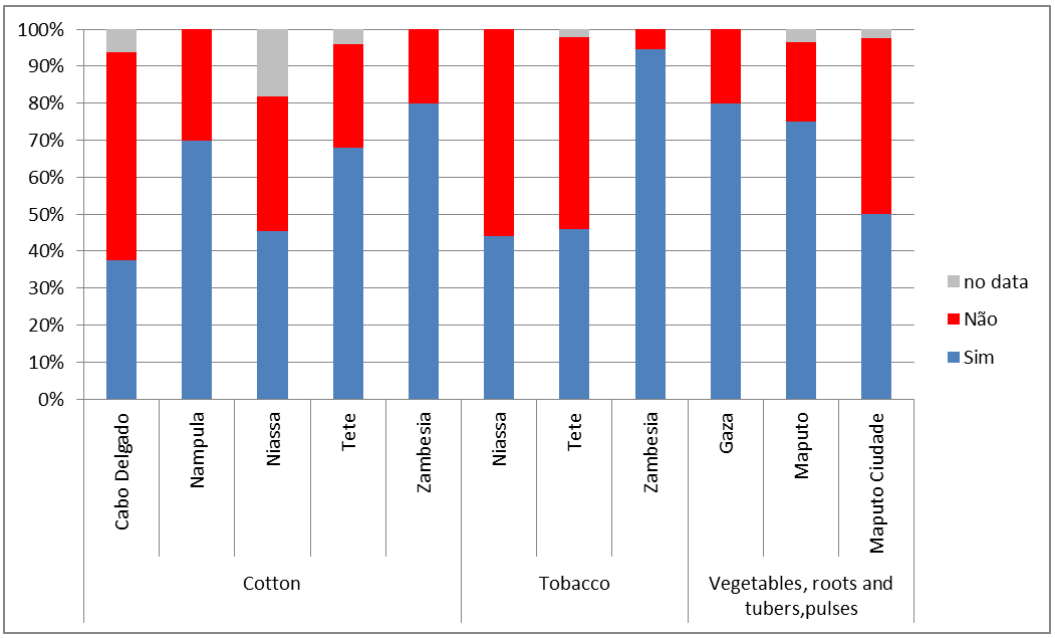


Figure 21 percentage of farmers read the label per province and crops

Table 11 farmers reporting to understand the pesticide label dosage

Row Labels	null	Não	Sim	Sim, com ajuda do técnico da empresa
Cabo Delgado	**6.25%**	**0.00%**	**93.75%**	**0.00%**
Cotton	6.25%	0.00%	93.75%	0.00%
Gaza	**0.00%**	**26.67%**	**73.33%**	**0.00%**
Vegetables, roots and tubers,pulses	0.00%	26.67%	73.33%	0.00%
Maputo	**7.14%**	**7.14%**	**85.71%**	**0.00%**
Vegetables, roots and tubers,pulses	7.14%	7.14%	85.71%	0.00%
Maputo Ciudade	**0.00%**	**37.50%**	**62.50%**	**0.00%**
Vegetables, roots and tubers,pulses	0.00%	37.50%	62.50%	0.00%
Nampula	**0.00%**	**85.00%**	**15.00%**	**0.00%**
Cotton	0.00%	85.00%	15.00%	0.00%
Niassa	**5.56%**	**83.33%**	**11.11%**	**0.00%**
Cotton	18.18%	72.73%	9.09%	0.00%
Tobacco	0.00%	88.00%	12.00%	0.00%
Tete	**2.74%**	**46.58%**	**50.68%**	**0.00%**
Cotton	4.00%	48.00%	48.00%	0.00%
Tobacco	2.08%	45.83%	52.08%	0.00%
Zambesia	**2.94%**	**5.88%**	**88.24%**	**2.94%**
Cotton	6.67%	13.33%	80.00%	0.00%
Tobacco	0.00%	0.00%	94.74%	5.26%
Grand Total	**3.38%**	**33.23%**	**63.08%**	**0.31%**

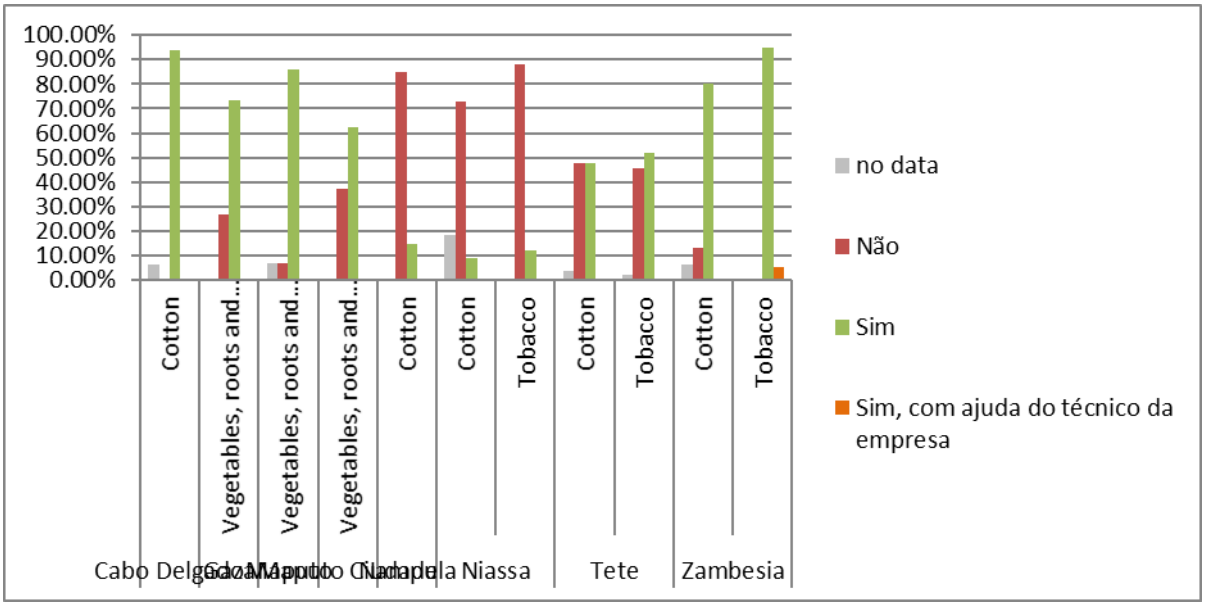


Figure 22 farmers reporting to understand the pesticide label dosage

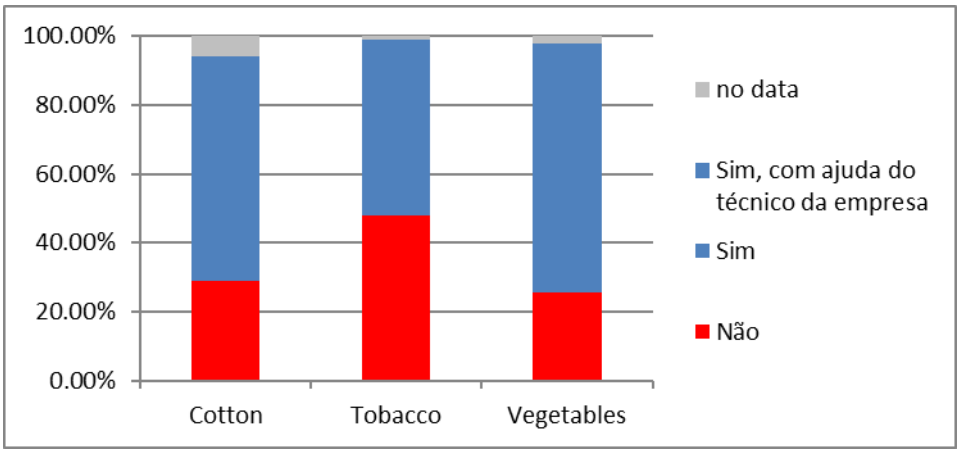


Figure 23 farmer reporting understanding the pesticide dosage instruction on the label per crop

3.3.4. Pesticide storage practices

About a third of farmers are storing pesticides inside their house

Provinces	Number of farmers storing the pesticide Inside the house	Number of farmers storing outside the house	Number of farmers
Cabo Delgado	33	21	60
Gaza	4	20	29
Maputo	1	25	28
Maputo Ciudade		38	38
Nampula	3	14	20
Niassa	16	16	34
Tete	50	15	70
Zambesia		33	34
Grand Total	**107**	**182**	**313**

Figure 24 pesticide storage practices per province

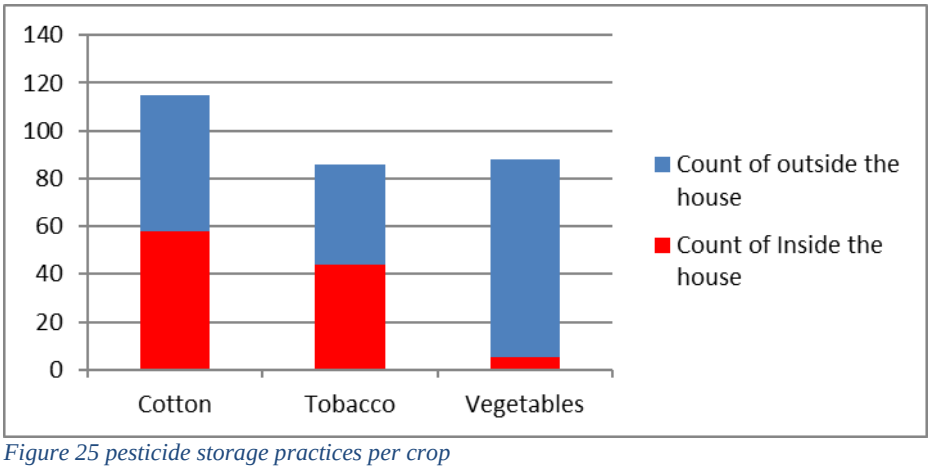


Figure 25 pesticide storage practices per crop

Preliminary discussion and conclusions

The survey results showed that the use of pesticides in general, and of HHPs in particular, was likely to result in undue exposure of farmers in the Mozambique.

Half of the farmers interviewed in the survey had not received any sort of training in using agrochemicals, and even those who had often lacked a good understanding of the risks involved through poor label reading and understanding and poor wearing of PPE. Many farmers in Mozambique do not have the required literacy and numeracy rate to even be able to understand the label. In addition PPE is often difficult to find, and expensive. As a result of all those reasons, the great majority of farmers survey (93%) did not wear appropriate protection to handle any HHPs and potentially neither a big share of the pesticides used.

For what concerns risk mitigation, it is difficult to enforce risk reduction measures that depend on wearing the appropriate PPE in these conditions. A further risk assessment is suggested by the survey and IPM programme targeting especially vegetables and cotton would improve the sustainability of the agricultural sector of Mozambique.

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REPORT

2ND FAO/WHO JOINT MEETING ON PESTICIDE MANAGEMENT

and

4TH SESSION OF THE FAO PANEL OF EXPERTS ON PESTICIDE MANAGEMENT

6 – 8 October 2008
Geneva

Food and Agriculture Organization of the United Nations

World Health Organization

Table of contents

Abbreviations

ADI	Acceptable Daily Intake
ASP	Africa Stockpiles Programme
CCPR	Codex Committee on Pesticide Residues
CIEN	Chemicals Information Exchange Network
CMR	Carcinogenic, Mutagenic and Reproductive toxicant
FAO	Food and Agriculture Organization of the United Nations
GCDPP	Global Collaboration for Development of Pesticides for Public Health
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
GLP	Good Laboratory Practice
GMP	Global malaria Programme
HHP	Highly Hazardous Pesticide
HQ	Headquarters
IARC	International Agency for Research on Cancer
ICC	International Chamber of Commerce
ICCM	International Conference on Chemicals Management
ICSC	International Chemical Safety Card
IFCS	Inter-governmental Forum on Chemical Safety
IGO	Inter-governmental Organization
IOMC	Inter-Organization Programme for the Sound Management of Chemicals
IPCS	International Programme on Chemical Safety
IPM	Integrated Pest Management
IVM	Integrated Vector Management
JMPR	Joint Meeting on Pesticide Residues
JMPS	Joint Meeting on Pesticide Specifications
MEA	Multilateral Environmental Agreement
MRL	Maximum Residue Limit
NGO	Non-governmental Organization
OECD	Organization for Economic Co-Operation and Development
PAN	Pesticide Action Network
PIC	Prior Informed Consent
PIM	Poisons Information Monograph
POP	Persistent Organic Pollutant
SAICM	Strategic Approach to International Chemicals Management
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNITAR	United Nations Institute for Training and Research
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation System

1. Introduction

The 2nd FAO/WHO Joint Meeting on Pesticide Management and 4th Session of the FAO Panel of Experts on Pesticide Management, were held at WHO Headquarters in Geneva from 6 to 8 October 2008.

The FAO Panel of Experts on Pesticide Management is the official statutory body that advises the Organization on matters pertaining to pesticide regulation and management, and alerts it to new developments, problems or issues that otherwise merit attention. The Panel in particular counsels FAO on the further implementation of the revised version of the *International Code of Conduct on the Distribution and Use of Pesticides*[1] (the Code of Conduct). Members of the WHO Panel of Experts are drawn from the WHO Panel of Experts on Vector Biology and Control, or are academic or government experts invited to advise the Organization on policies, guidelines and key actions to support Member States on sound management of pesticides.

Experts invited to this meeting have been selected for their personal expertise and experience in specific aspects of pesticide management, both in agriculture and in public health, and do not represent the position of governments or institutions they may belong to. They are appointed in their personal capacity by either FAO or WHO. In addition, representatives from other Inter-Governmental Organizations (IGOs), pesticide industry and Non-Governmental Organizations (NGOs) also attended the meeting as observers.

Dr Morteza Zaim welcomed all participants on behalf of WHO and expressed his great pleasure in hosting the joint meeting for the first time in Geneva. He thanked all present for kindly having responded to the invitation to participate in the meeting.

Mr Mark Davis, of FAO, noted the absence of Dr Gero Vaagt, former Senior Officer of the FAO Pesticide Management Group, who had been called to other duties. He recalled the long involvement of Dr Vaagt in the organization of this Panel and noted that his experience would be greatly missed. Mr Davis underlined the importance of the guidance which the Panel is providing, in particular to developing countries, which are in the complicated situation of having to balance trade, health and environmental interests.

All participants in the meeting are listed in Annex 1.

2. Opening of the meeting

Dr Lorenzo Savioli, Director Control of Neglected Tropical Diseases, gave the opening address on behalf of Mr Hiroki Nakatani, Assistant Director General of WHO. He welcomed the Panel members from FAO and WHO and colleagues from other UN organizations and the World Bank to the meeting, as well as representatives of industry associations and public interest groups who attended the meeting as observers.

[1] http://www.fao.org/agriculture/crops/core-themes/theme/pests/pm/code/en/

Dr Savioli reminded the participants that the Panel has an advisory role to FAO and WHO on policies, guidelines and key actions to support Member States on the sound management of pesticides. He stressed that the strengthening of capacity for judicious and effective management of pesticides is a priority for WHO and that the collaboration with FAO provides an opportunity to ensure complementarity, harmonized and coordinated guidance and support to Member States and other stakeholders on this important issue.

The Director underlined that Integrated Vector Management (IVM) is being promoted by WHO as a key strategy for the sound management of pesticides. Capacity building in the field of public health pesticides is an important element of IVM, in particular given the increased use of insecticides in the health sector in many vector-borne disease endemic countries where resources and infrastructure for such activities are often inadequate.

Dr Savioli noted that important guidance documents are being prepared by the Panel and requested the meeting to ensure that these are pragmatic and useful to the main target groups, which are governments of developing countries and countries with economies in transition. He emphasized that the Code of Conduct serves as a framework and guiding document for both FAO and WHO and invited the Panel to carefully review the Code and advise whether any improvements can be made to the document to better address the specific needs of public health pesticides.

Finally, Dr Savioli, wishing the meeting success and stating he looked forward to its recommendations, declared the 2nd FAO/WHO Joint Meeting on Pesticide Management open.

3. Election of the chairperson and rapporteurs

Dr Vibeke Bernson was elected Chairperson of the meeting, and Dr Gamini Manuweera and Dr Sandhya Kulshrestha were appointed rapporteurs.

4. Adoption of the agenda

One additional issue was included under agenda item 13: counterfeiting and illegal trade in pesticides.

The definitive agenda was adopted as shown in Annex 2.

5. Developments since the previous session of the Panel

A brief summary was presented of some important developments with respect to pesticide management that had taken place since the 1st Joint Meeting in October 2007.

5.1 WHO

Chemical safety

WHO Chemical Safety is in the process of updating the Poisons Information Monographs (PIMs) on dieldrin, endosulfan, paraquat and aluminium phosphide. PIMs are concise but comprehensive, internationally peer-reviewed documents about individual agents or groups of agents to which poisoning exposures may occur. The PIMs are primarily intended to facilitate the work of poison information specialists and clinicians in dealing with poisoning cases. They summarize the physico-chemical and toxicological properties of the substance, the clinical features of poisoning and patient management. These will be available on the INTOX and INCHEM websites[2].

Chemical Safety has also developed International Chemical Safety Cards (ICSCs). ICSCs summarize essential product identity data and health and safety information on pure chemicals for use by workers and employers, agriculture and for the public at large. There are now approximately 150 ICSCs on pesticides, available through the WHO web page of the International Programme on Chemical Safety (IPCS)[3].

Chemical Safety is undertaking a risk assessment of the use of DDT in indoor residual spraying for malaria prevention. The draft document will be released for public and peer review, followed by an expert meeting.

Food safety

The 2008 FAO/WHO Joint Meeting on Pesticide Residues (JMPR) was held in Rome, Italy, in September 2008. The meeting evaluated 26 pesticides, of which six were new compounds and six were re-evaluated within the periodic review programme of the Codex Committee on Pesticide Residues (CCPR).

JMPR consists of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group. During the Meetings, the FAO Panel of Experts is responsible for reviewing residue and analytical aspects of the pesticides under consideration, including data on their metabolism, fate in the environment and use patterns, and for estimating the maximum residue levels that might occur as a result of the use of the pesticides according to good agricultural practices. The WHO Core Assessment Group is responsible for reviewing toxicological and related data and for estimating, where possible, acceptable daily intakes (ADIs) for humans of the pesticides under consideration. Relevant information is accessible on the respective JMPR websites of FAO and WHO[4].

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[2] http://www.inchem.org and http://www.intox.org

[3] http://www.who.int/ipcs/publications/icsc/en/index.html

[4] http://www.who.int/ipcs/food/jmpr and http://www.fao.org/ag/AGP/AGPP/Pesticid/JMPR

Evidence, research and action on mental and brain disorders

Pesticide ingestion accounts for over 60 percent of suicides in many rural areas of China and South-East Asia and there is evidence of increased pesticide self-poisoning in Central and South American, as well as African countries. The WHO Team of Evidence, Research and Action on Mental and Brain Disorders of the WHO Department of Mental Health and Substance Abuse held a meeting in Nonthaburi, Thailand, in December 2007 to launch the global public health initiative *The Impact of Pesticides on Health: Preventing Intentional and Unintentional Deaths from Pesticide Poisoning*. The meeting identified actions for safer access to pesticides through community interventions.

The Team also published *Prevention of suicidal behaviours: Feasibility demonstration projects on community interventions for safer access to pesticides*[5]. The document provides draft protocols for the demonstration of feasibility of community-level interventions for safer access to pesticides and the identification of potential sites where to conduct those demonstration projects. The Team also convened a meeting on *Prevention of Suicidal Behaviours: Clinical Management of Acute Pesticide Intoxication*, in Nonthaburi, Thailand, in December 2007. The purpose of this meeting was to do an in-depth review of guidelines on the clinical management of acute pesticide intoxication and to develop clinical guidance for health care workers at different levels of the health care system (i.e., primary health care, district hospitals and specialized units) and a strategy for implementation.

Global Malaria Programme

The Global Malaria Programme (GMP) has produced an update on the WHO Position statement on DDT: The *Use of DDT for Malaria Control*, which includes increased focus on occupational and environmental safety guidance.

The GMP has been collaborating with UNEP and the Secretariat of the Stockholm Convention on Persistent Organic Pollutants (POPs), in providing technical support to countries for capacity building in the use of DDT according to the provision of the Convention. In this context, the Secretariat of the Convention has signed a memorandum of understanding with WHO to support countries in fulfilling their requirements for reporting to the Secretariat on the production and use of DDT for disease vector control.

Two national workshops on DDT reporting were held in 2008, respectively in Rabat, Morocco and in Sana'a, Yemen. Both workshops were preceded by a field visit conducted on assessment and support for safe storage of DDT. In July 2008 a three day inter-regional workshop was held in Bangkok, Thailand to improve the relevant processes for data collection, reporting systems and DDT stocks management in each of the participating countries, i.e., China, Democratic People's Republic of Korea, India, Myanmar, Papua New Guinea and Solomon Islands. As part of these regional and country workshops support was also given to countries to assess the capacities of countries for environmentally sound management of DDT stocks and wastes and discuss the introduction of alternatives to DDT and the strategies to be used to reduce the reliance on DDT.

[5] http://www.who.int/mental_health/resources/suicide/en/index.html

WHOPES

The WHO Pesticide Evaluation Scheme (WHOPES) finalized the testing and evaluation of 5 pesticide products and developed recommendations on their use in public health[6]. The reports of the WHOPES Working Group meetings provide critical reviews of existing literature as well as of studies organized and supervised by WHOPES. These reports are widely distributed among national control programmes, registration authorities and other stakeholders and are intended to facilitate the registration and safe and effective use of such products by Member States.

The 7th FAO/WHO Joint Meeting on Pesticide Specifications (JMPS), held in Braunschweig, Germany, in June 2008, reviewed data package of 19 manufacturers of pesticides (ten for FAO specifications; two for WHO specifications; and seven for joint FAO/WHO specifications) and made recommendations for the development of quality standards for these products.

In collaboration with FAO, WHOPES developed a training manual on the development of pesticide specifications. This tool provides a step-by-step approach to acquiring the knowledge and skills for basic decision-making on the development of pesticide specifications, including the determination of equivalence, following the principles, criteria and procedures detailed in the *Manual on development and use of FAO and WHO specifications for pesticides*[7]. The planned training activities of the two Organizations are expected to support capacity building of the national programmes in the implementation of the Code of Conduct, especially as it relates to Article 6.1.4.

The sixth meeting of the Global Collaboration for Development of Pesticides for Public Health (GCDPP) was held at WHO headquarters, in April 2008. The meeting was attended by representatives of industry, national and government-supported agencies, regional and international organizations, and universities and research institutions, as well as several WHO resource persons, mainly from pesticide registration authorities. The meeting discussed the draft FAO/WHO guidelines on registration of pesticides and advised WHO on the refinement of the guidelines so that they are pragmatic and useful for the main target groups.

WHOPES is in the process of peer review of three generic risk assessment models for application of insecticides in indoor residual spraying, space spraying and mosquito larviciding, as well as three efficacy guidelines for mosquito skin repellents, ground-applied space spray products and household insecticide products. All six guidelines are expected to be published by mid-2009.

Housed in the WHO Vector Ecology and Management Unit, WHOPES has supported the activities of the Unit in supporting Member States in incorporating the principles IVM into their national policies. IVM is highly promoted by WHO for the optimal use of resources for vector and public health pest control and as a key strategy for sound management of pesticides.

WHOPES has also, in collaboration with WHO Regional Offices, initiated situation analyses and needs assessments for strengthening capacity on sound management of pesticides in 12

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6 http://www.who.int/whopes/recommendations/wgm/en/

7 http://whqlibdoc.who.int/publications/2006/9251048576_eng_update2.pdf

priority countries in Asia, Africa and South America, through multi-sector and multi-stakeholder approaches. WHOPES also attended the WHO/EURO meeting on Sound Management of Pesticides – Risk Reduction, in Bonn, Germany, in August 2008. The meeting was attended by representatives of 18 Member States, mainly from Eastern Europe, the Caucasus and Central Asia, and recommended on actions to reduce risks associated with the use of such chemicals in agriculture and health.

5.2 FAO

Organizational changes

The Panel was informed that the Plant Production and Protection Division, which hosts the pesticide management programme at FAO, is going through a process of restructuring which should lead to closer integration of crop production and protection activities. Issues related to pesticide management used to be handled by the Pesticide Management Group, but will now be under a Programme Entity responsible for the reduction of risks associated with pesticide use in agriculture to protect human health and the environment, which has three main objectives:

- implementation of the Code of Conduct, including the progressive elimination of highly hazardous pesticides. This objective also covers the work of the JMPR and the JMPS;
- national capacity building for implementation of the Code of Conduct. This objective covers, among other activities, human health risk assessment, strengthening of laboratory capacity, the development of national action plans, implementation of IPM, the safeguarding of obsolete pesticides stocks, etc.;
- communication, knowledge management and associated capacity building services in support of pesticide risk reduction, which includes such activities as the development of guidelines in support of the Code of Conduct, the deployment of pesticide stock management systems, the publication of the joint FAO/WHO training manual on pesticide specifications, information tools on herbicide resistance, etc..

Furthermore, the departure of the Senior Officer Pesticide Management at FAO has led to a reassignment of tasks to other staff within AGP. However, it has also led to a reduction in capacity to implement some of the planned activities related to pesticide management, including some recommendations made previously by the Panel. It is expected that this post will be filled again by mid-2009.

Food safety

The Codex Committee on Pesticide Residues (CCPR) met for its 40th Session, in Hangzhou, China, in April 2008. In addition to the adoption of (draft) Maximum Residue Limits (MRLs) and the revocations of some existing MRLs, the CCPR discussed options for setting globally harmonized MRLs through Codex. This might be achieved by the definition of Codex MRLs before most national MRLs have been set. The implications of such a system on the work of the CCPR and the JMPR would be considerable, though, and these will be further evaluated before the next session. The report of the CCPR is available on the Codex web site[8].

[8] http://www.codexalimentarius.net/web/archives.jsp?year=08

In addition to the work carried out by the JMPR in 2008 referred to under section 5.1, the attention of the Panel drawn to the ongoing FAO/WHO-IPCS project to update principles and methods for the risk assessment of chemicals in food[9].

Minor uses

A Global Minor Use Summit was organized jointly by FAO, the US Department of Agriculture (USDA), the US Environmental Protection Agency (USEPA), and IR-4 Project, at FAO headquarters in December 2007. The summit focussed on finding solution for constraints regarding the generation of data for the registration of pesticides, and other regulatory issues, for minor use or specialty crops.

The summit discussed such issues as the generation of residue data, the promotion of extrapolation of data between different uses (e.g., through zoning or crop grouping), strengthening information and data sharing, and the development of harmonized, global guidance. The final recommendations of the summit can be found on FAO's web site[10].

Obsolete pesticides

Regarding the management and disposal of obsolete pesticides, the Panel was informed that a second phase of the Africa Stockpiles Programme (ASP) is being developed. Noticeably, a much greater emphasis will likely be placed on the importance of sound pesticide management for the prevention of accumulation of obsolete pesticide stocks.

In addition, FAO is in the process of setting up new projects on the management and disposal of obsolete pesticides in Eastern Europe, the Caucuses and Central Asia; the Middle East; the Andean countries and Paraguay; and India and Vietnam (with UNDP).

Rotterdam Convention

The number of Parties to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (the Rotterdam Convention) continues to increase its scope and impact. The number of Parties increased to 126, while national implementation plans for the Convention have been developed for 52 countries, and is continuing.

The Chemical Review Committee, in March 2008, recommended the inclusion of two new pesticides into its Annex III (the PIC procedure): aldicarb and alachlor. Furthermore, the upcoming Conference of Parties of the Convention, later in October 2008, will consider the inclusion of the pesticides TBT and endosulfan into Annex III.

Trends in international agriculture

The year 2008 has seen the emergence and increased importance of a number of global issues which have a direct impact of agricultural production, such as spiralling food prices, the promotion of bio-fuels and the consequences of climate change. These trends have focused international attention on agriculture again, after a long period of relative neglect. The implications of these global trends on (increased) pesticide use are already being noted. This underlines the importance of continued efforts to ensure sound pesticide management.

[9] http://www.who.int/ipcs/food/principles/en/

[10] http://www.fao.org/ag/AGP/AGPP/Pesticid/

Monitoring implementation of the Code of Conduct

The previous session of the Joint Meeting discussed two *ad hoc* cases of monitoring observance of the Code of Conduct.

In response to the provisions of the Guidelines on Monitoring and Observance of the Code of Conduct, and in particular its Annex I, FAO sent out an invitation to provide a Regular Monitoring Report on implementation of the Code of Conduct to all its member countries, in July 2008. The deadline for receipt of reports was set at 30 October 2008.

Results of this monitoring exercise will be analysed in the course of 2009, and a report on implementation of the Code of Conduct in FAO member countries should be available at the next session of the Joint Meeting. The report should assist FAO, WHO and the Panel in identifying and/or strengthening priorities for further implementation of the Code of Conduct.

5.3 UNEP

UNEP Chemicals presented its activities for strengthening sound management of pesticides, much of which is carried out in support of SAICM and chemicals-related multilateral agreements. They include activities related risk assessment, management and communication, such as:

- facilitating development of tools for guidance and training in methods for risk assessment and management to be used in capacity building in developing countries and economies in transition;
- promoting the development, exchange and communication of information on reduction of chemicals exposures and effects of chemicals on in particular for sensitive groups and ecosystems;
- supporting activities to minimize effects of natural disasters and industrial accidents involving chemicals;
- mainstreaming of chemicals management into national development agendas.

Pesticide risks

A particular issue with respect to pesticides which UNEP intends to focus on over the next few years are the environmental risks of pesticides in the tropics. In this respect, limited funding has been programmed for the period 2009 – 2011.

Information systems

Several information systems have been put in place, which are of particular relevance for pesticide management:

- the *POPs Laboratory Databank*, a global database of laboratories capable of analyzing POPS. The database provides information, for each laboratory, of the type of analyses that are carried out, the matrices in which POPs can be detected, methods being used, and quality assurance aspects[11];

[11] http://www.chem.unep.ch/databank/Home/Welcome.aspx

- the *Information System on DDT in Disease Vector Control*, which is operated in collaboration with the WHO Global Malaria Programme and the Stockholm Convention[12]. The system provides relevant up-to-date information and guidance on DDT and its alternatives in disease vector control. It was especially developed as a tool for exchanging data, experiences and expertise on the management and use of DDT within and between regions;
- the *Information System on POP Termiticides and Alternatives*, which aims to provide easy access to relevant information and guidance materials on termites and options for their management without POP termiticides[13];
- the *Chemical Information Exchange Network* (CIEN), which was set up as a mechanism to help networking and collaboration among various stakeholders responsible for the environmentally sound management of chemicals[14]. Twelve countries in Africa now have national CIEN web sites to facilitate national information exchange on chemicals;

5.4 Other organizations

The representative of UNITAR informed the meeting about its activities on capacity building for chemicals and waste management. UNITAR is assisting 25 countries in implementing SAICM. It also has a collaborative programme with the Rotterdam Convention, in particular to develop national action plans for its implementation.

The participants were also informed about activities related to pesticide risk reduction carried out by the OECD. A number of seminars has been organised on specific topics, in which non-OECD countries have taken part, the latest of which was the workshop on *Risk Reduction through Better Worker Safety and Training*. Its report has been published earlier in 2008[15].

The Pesticide Action Network (PAN) brought to the attention of the meeting that it had taken up the issue of risk reduction from highly hazardous pesticides (HHPs). A community monitoring exercise had been started to collect information of human health effects caused by pesticides. Furthermore, a first draft of a list of HHPs is presently being elaborated by PAN.

[12] http://www.chem.unep.ch/ddt/Default.html

[13] http://www.chem.unep.ch/termites/Default.html

[14] http://jp1.estis.net/communities/cien/

[15] http://www.oecd.org/department/0,3355,en_2649_34383_1_1_1_1_1,00.html

6. Highly hazardous pesticides

6.1 Identifying highly hazardous pesticides

The previous session of the Panel defined a number of criteria to define HHPs. Following publication of these criteria, feedback was received with regard to the clarity of the criteria and their completeness. Therefore, a number of criteria were revisited by the Panel.

WHO classification

A presentation was made by the WHO on the *WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification*[16], in particular the approach taken for the inclusion of certain chronic hazards (the "CMR" criteria: carcinogenicity, mutagenicity and reproduction toxicity). At present, pesticides classified by the International Agency for Research on Cancer (IARC) as having a high likelihood of being carcinogenic, are specifically identified in the WHO Classification. Reproductive toxicity is taken into account on a case-by-case basis, but not all pesticides listed in the classification have been evaluated against this hazard.

Concern was expressed that CMR hazards have not been, and are presently not, systematically evaluated for all pesticides listed in the WHO Classification. It therefore, contrary to acute hazards, may not provide a complete classification of CMR hazards. However, the only other global hazard classification, the *Globally Harmonized System for the Classification and Labelling of Chemicals* (GHS)[17], while providing criteria for CMR hazards, does not evaluate individual pesticides against these criteria. Systematic evaluation of individual pesticides against the CMR criteria of the GHS, and inclusion of its results in the WHO Classification, would according to the Panel be extremely useful.

The Panel underlined the longstanding use and great importance of the WHO Classification for many aspects of pesticide management and regulation, in particular in developing countries. It noted its wide use in registration, classification and labelling, among others.

The Panel reiterated its previously expressed concern that that the acute toxicity classifications of the WHO system and of the GHS have not yet been harmonized. It therefore recommended that WHO, as soon as possible, harmonize its criteria for acute toxicity with those of the GHS. The Panel further recommended that WHO should assess the feasibility of incorporating the GHS CMR criteria, and possibly other relevant endpoints, into its Classification. Pesticides listed in the Classification would subsequently need to be evaluated against these criteria, so that the WHO Classification can be considered comprehensive and complete, not only for acute hazards but also for the most important chronic hazards. The Panel recognized, however, that such evaluations would require considerable resources.

Endocrine disrupting pesticides

Endocrine disrupting effects were not incorporated into the list of criteria for HHPs as defined by the previous session of the Panel. A presentation was therefore made by PAN on the status of knowledge about endocrine disrupting pesticides.

[16] http://www.who.int/ipcs/publications/pesticides_hazard/en/

[17] http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

It was stressed in this presentation that endocrine disruption by chemicals should not be considered an emerging issue anymore. Much scientific work has been carried out on the effects of endocrine disruption and the toxicological and physiological explanatory mechanisms. A summary of these mechanisms, as well as the resulting adverse effects, was presented to the Panel.

PAN noted that a number of countries have started taking action in regulating endocrine disrupting chemicals, including pesticides. As a first step, several countries, such as the European Union, Japan and the United States of America have started listing potential endocrine disrupting chemicals and identifying those that require further regulation. Furthermore, the OECD has initiated a research programme which is expected to lead, shortly, to a battery of new and revised testing guidelines to detect endocrine disruptors.

It was recognized in the presentation that there still is no full understanding of all the mechanisms by which pesticides affect the endocrine system, and the adverse effects this may cause. However, PAN was of the view that there is sufficient information on endocrine disrupting pesticides, with assay guidelines well developed by OECD in conjunction with the European Union, Japan and the United States of America, to move forward and regulate at least those pesticides already identified by the European Union. As a result, PAN urged FAO and WHO to include endocrine disruption as a criterion for HHPs.

The Panel welcomed the considerable advancements in the development of harmonized testing guidelines and evaluation criteria for endocrine disrupting chemicals. However, it noted that the OECD harmonized testing guidelines had not yet been published, and the European Union list of likely endocrine disrupting chemicals requiring regulation had not yet been formally adopted. Furthermore, there is still much discussion about the variety in effects that may be caused by endocrine disruptors, questions regarding potency, and effective approaches to assess their actual risk. The Panel also noted that endocrine disruption is not a toxicity endpoint as such and often will lead to toxic effects such as cancer or reproductive effects. Such effects would be covered by the criteria for HHPs.

The Panel, therefore, felt it was premature to include specific reference to endocrine disruptors as a separate category of highly hazardous pesticides. However, the Panel recognized that endocrine disruption can be an important mechanism of pesticide hazard expression. It was recommended that this issue be closely followed, and that the Panel should review the extent to which the existing criteria address endocrine disrupting pesticides at one of its future sessions.

Criteria for HHPs

Based on its discussions, and with the aim to ensure that its criteria for HHPs are clear and unequivocal, the Panel recommended that the criteria published at its 2007 session be slightly revised, and read as follows.

Highly hazardous pesticides should be defined as having one or more of the following characteristics:

- pesticide formulations that meet the criteria of classes Ia or Ib of the *WHO Recommended Classification of Pesticides by Hazard*;

  or

- pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

  or

- pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

  or

- pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

  or

- pesticide active ingredients listed by the *Stockholm Convention* in its Annexes A and B, and those meeting all the criteria in paragraph 1 of annex D of the Convention;

  or

- pesticide active ingredients and formulations listed by the *Rotterdam Convention* in its Annex III;

  or

- pesticides listed under the *Montreal Protocol*;

  or

- pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

With respect to the last criterion, the Panel requested WHO, FAO and UNEP to develop workable criteria on how to determine whether pesticide active ingredients and their formulations have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

Pesticide industry representatives indicated that criteria to identify highly hazardous pesticides which are entirely hazard-based would not be supported by them, and risk assessment should be the basis for regulatory decision making.

6.2 Priority activities for risk reduction

The Panel recalled the recommendation made by the 131st session of the FAO Council, in 2006, with respect to FAO's contribution to SAICM, which read:

In view of the broad range of activities envisaged within SAICM, the Council suggested that the activities of FAO could include risk reduction, including the progressive ban on highly hazardous pesticides, promoting good agricultural practices, ensuring environmentally-sound disposal of stock-piles of obsolete pesticides and capacity-building in establishing national and regional laboratories.

The previous session of the Panel made a number of recommendations with respect to risk reduction of HHPs. FAO informed the meeting that regrettably little progress had been made with implementation of these recommendations, to a large extent due to limitations in personnel (see section 5.2). FAO stressed, however, that risk reduction of HHPs would remain a high priority in its programme, as recommended by the FAO Council.

The previous Panel recommendation that FAO and WHO, as a first step, prepare as list of HHPs based on the criteria identified, had not been taken up. FAO indicated it would be very hesitant to develop such a list, since its relationship to existing Multilateral Environmental Agreements (MEAs) that have more extensive identification procedures, in particular the Rotterdam Convention, might cause confusion in implementation at country level. In addition, preparing a list of individual pesticides classified as a HHP will likely result in long and complicated discussions, which may divert attention from the main task of reducing the risks posed by HHPs.

FAO therefore suggested that the first step of implementing the criteria defined by the Panel may be to develop guidance for registrars on how to apply the criteria for the national authorization of pesticides. Such guidance would also include available relevant data sources needed to use the criteria, and advice on elements and procedures for decision making, in particular with respect to viable alternatives for HHPs. As a second step, FAO and WHO could then actively engage regulators at the national level and assist them in implementing risk mitigation measures for HHPs.

The Panel stressed that registrars in many developing countries need clear guidance on what should be considered HHPs and what type of risk reduction measures can be taken. At present, most countries concerned already lack manpower and technical expertise to carry out proper hazards assessment for pesticides, let alone complete risk assessments.

The Panel revisited its previous recommendations made on priority activities for risk reduction. It noted that most of these recommendations still stand, but suggested to make a number of amendments to further clarify actions that should be taken to reduce risks that are posed by HHPs.

The Panel noted that many HHPs are currently in use, and reiterated that substituting them by less hazardous pest management options will often take time. However, as a general principle, the Panel recommended that HHPs should not be registered for use unless:

i. governments establish a clear need;

ii. no alternatives, based on a risk – benefit analysis, are available; and

iii. control measures as well as good marketing practices are sufficient to ensure that the product can be handled with acceptable risk to human health and the environment.

The Panel considered that the following activities should be a priority for FAO and WHO, with the aim to reduce the risks from HHPs, which explicitly could include a progressive ban of these compounds:

- FAO and WHO, as a first step, should make available to countries information on HHPs based on the criteria above, update it periodically in cooperation with UNEP, and make it widely known;
- FAO, in collaboration with WHO, should invite governments and the pesticide industry to develop plans of action to reduce risks from HHPs by taking regulatory or technical

action, either at the national or the regional level as appropriate, taking into account the work undertaken in existing MEAs such as the Stockholm Convention, Rotterdam Convention and the Montreal Protocol;

- FAO, in collaboration with WHO, should collect information on alternatives for HHPs, both reduced risk pesticides and other pest management approaches, in cooperation with all relevant stakeholders, and share experiences among countries;
- FAO, in collaboration with WHO, should seek assistance from donors for countries which wish to act to reduce risks from HHPs with the aim of preparing, implementing and enforcing action plans and search for alternatives;
- FAO should mobilize internal and external resources in order to implement, as a priority, the recommendations of the FAO Council with respect to HHPs.

The Panel underlined that effective risk reduction from HHPs is mainly carried out at the national level, and that national governments thus have the prime responsibility in this respect. It therefore recommended that FAO, in collaboration with WHO, invite national governments to ensure that at least the following risk reduction measures for HHPs are taken into account:

- identify HHPs with help of the criteria explained above;
- review the need for the use of HHPs, while simultaneously reviewing use conditions, mitigation measures and comparative risk assessment;
- where a specific need is identified for a HHP and no viable alternatives are available, governments should be advised to take all the necessary precautions, mitigation measures and apply restrictions, that may include the use only under certain conditions or by specifically certified users, severe restrictions, or a possible phase-out;
- promote the use of alternative pest management strategies and, in case they are not available, promote research for development of alternative strategies;
- promote the substitution principle for HHPs;
- ensure the provision of sufficient advice and information to users.

Finally, the Panel noted that the Global Guide to Resources on Acute Toxic Pesticides, which had been prepared by the Intergovernmental Forum on Chemical Safety (IFCS) to assist its recommendations on acutely toxic pesticides, is still being updated regularly[18]. The Panel suggested that FAO and WHO, as well as national government, could also use this guide to further identify and implement priority activities for risk reduction of HHPs.

[18] http://www.who.int/ifcs/champions/guide_resources/en/index.html

7. Guidelines in support of the Code of Conduct

As an introduction to the discussions on the various guidelines being developed in support of the Code of Conduct, the Panel was informed of newly published or translated guidelines since the its previous session, in October 2007:

- the publication, in May 2008, of the joint FAO/WHO *Guidelines on Management Options for Empty Pesticide Containers.*[19]
- the translation into French and Spanish of the FAO *Guidelines on Monitoring and Observance of the Code of Conduct*.[20]
- the translation into Arabic of the FAO *Guidelines on Efficacy Evaluation for the Registration of Plant Protection Products*.[21]
- the publication of the FAO Legislative study No. 97 – *Designing National Pesticide Legislation*.[22]

The Panel was also informed that, because of legal requirements at WHO and the wish to operate a consistent guideline drafting procedure within both organizations, FAO and WHO have decided that guidelines in support of the Code of Conduct would in the future only be drafted by independent experts. FAO and WHO underlined that this procedure would be adhered to avoid any appearance of a conflict of interest, and not because there had been any reservation with respect to the technical quality of previous guidelines. Guidelines presently in the process of being drafted are not affected by this change of policy. Pesticide industry associations and public interest groups would continue to be invited to participate in Task Groups for specific guidelines as observers, and provide inputs in the drafting process.

8. Drafting status of guidelines under development

The Panel was presented with the drafting status of a number of guidelines that are presently being developed.

8.1 Guidelines on resistance management for pesticides

The Panel reviewed a first working draft of the *Guidelines on Resistance Management for Pesticides* at its previous session. Additional comments on this draft had been received subsequently and had been incorporated into a second draft by the drafter in close collaboration with the Task Group chair. The second draft had been reformatted by FAO and was being completed by the drafter.

The Panel requested the Task Group chair and the drafter to finalize the draft by January 2009, to be circulated for review by the Task Group and by a limited number of independent

[19] http://www.fao.org/agriculture/crops/core-themes/theme/pests/pm/code/frame/implement/obsolete/en/

[20] http://www.fao.org/agriculture/crops/core-themes/theme/pests/pm/code/frame/monitor/en/

[21] http://www.fao.org/agriculture/crops/core-themes/theme/pests/pm/code/frame/implement/regpes/en/

[22] http://www.fao.org/legal/legstud/list-e.htm

peer reviewers. External peer reviewers should be selected based on their expertise in pesticide resistance management, both in agriculture and in public health, by FAO and WHO in consultation with the Task Group chair. The Panel recommended that comments received be taken into account in finalizing this draft, and that it subsequently be circulated among Panel members and observers for review, by June 2009. A final version of the guideline should be presented to the Panel for endorsement by October 2009.

8.2 Guidelines on registration of microbial pest control agents

With respect to the *Guidelines on Registration of Microbial Pest Control Agents*, the Panel took note of the fact that a draft had been prepared based on the outline agreed during its previous session. This draft was circulated among the Task Group members and comments were incorporated by the drafter. The second draft will require reformatting, to be in line with the agreed guideline format.

The Panel requested that this draft be finalized and reviewed by the Task Group by January 2009, and subsequently be sent for external peer review. External peer reviewers should be selected based on their expertise in the registration of microbial pest control agents, both in agriculture and in public health, by FAO and WHO in consultation with the Task Group chair. The Panel recommended that the peer review be taken into account in finalizing this draft, and it be circulated subsequently among Panel members and observers for comments, by May 2009. A new version of the guideline should be presented to the Panel for endorsement, by October 2009.

8.3 Guidance on pest and pesticide management policy development – agriculture.

A draft of the *Guidance on Pest and Pesticide Management Policy Development (Agriculture)* had been discussed by the Panel at its previous session. Subsequently, additional comments were provided which differed substantially from each other and did not represent a clear consensus on the changes to be made. This resulted in a new draft of the document, which had not yet been circulated among the Task Group or full Panel.

The Panel discussed the status and process of development of this draft guideline. It requested FAO to circulate the newly revised draft among the Task Group members for review, by January 2009, to assess whether previous comments have been incorporated in an acceptable manner. Since the latest comments were all provided Task Group members, the Panel recommended that the Task Group consider calling an external independent peer review of the guidance document if certain key elements would remain unresolved. The Panel recommended that a final draft then be prepared, and circulated among Panel members for endorsement by June 2009. If no major comments were to be received on the final draft, FAO was requested to finalize the guidance document and subsequently proceed with publication prior to the Panel's next session.

9. Review of outlines for new or revised guidelines

The Panel was presented with one draft outline for a new guideline to be developed.

9.1 Guidelines on retail establishments for pesticides

A revised scope and outline was presented of the *Guidelines on Retail Establishments for Pesticides*, based on the suggestions made the Panel during its previous session. The Panel confirmed its previous recommendation that the guideline should focus on providing advice to governments on the establishment of a proper system and setting minimum requirements of pesticide distribution and sales within the country. Guidance to be provided to retailers was considered to be the main responsibility of individual governments and of the private sector itself.

The Panel underlined the very important role that retailers play in the pesticide management chain, in particular in developing countries, where they tend to be the prime source of information for pesticide users, not only on the products themselves but also on pest management in general. The effective organization and regulation of retail outlets should therefore be a priority and the guideline should provide minimum requirements in this respect.

The Panel made a number of suggestions regarding the contents of guideline, which included:

- ensuring that distribution and sales of all types of pesticides, including agricultural, public health and domestic use products are covered;
- taking into account different types of retail outlets which may cater for different groups of pesticide users (e.g., general public, farmers, professional pest control operators);
- addressing forms of retail specific to many developing countries, such as travelling salesmen and mixed retail shops (e.g., 'one-stop shops' selling all agricultural inputs and materials, or even other types of goods);
- including options for retailer licensing, and the problem encountered in various countries that license holders may not be the actual shopkeepers;
- addressing in sufficient detail elements on labelling, packaging, storage and disposal;
- stressing the need to avoid the risk of food contamination during storage;
- covering all articles of the Code of Conduct which are relevant of pesticide distribution and sales.

In addition, the Panel underlined the importance of training of and information provision to pesticide distributors and retailers, and of effective enforcement, and requested that this be taken into account in the guideline.

The Panel requested that FAO and WHO prepare a detailed annotated table of contents for this guideline by March 2009, and circulate it among Panel members and observers for comments. The Panel further recommended that the development of the guideline be initiated as soon as possible afterwards, so that a complete draft can be distributed for discussion at its next session.

10. Review of new and revised guidelines

The Panel was presented with three draft guidelines presently under development.

10.1 Guidelines on the development of a reporting system for health and environmental incidents resulting from exposure to pesticides

A draft version of the *Guidelines on the Development of a Reporting System for Health and Environmental Incidents Resulting from Exposure to Pesticides* had been discussed during the previous session of the Panel. Comments made by the Panel were incorporated and the draft went subsequently through an additional review round by a number of Panel members, observers and external reviewers. A final draft was then prepared and had been distributed to the Panel for endorsement.

The Panel commended the drafter for her excellent work in finalizing this guideline. The Panel recognized the importance of having a feedback system on possible adverse impact of pesticides within the country as a basis for effective interventions through policy and other options. While recognizing that the operation of a thorough and effective pesticide incident reporting and monitoring system is very complex and will require considerable resources, the Panel underlined that this guideline can provide guidance on how to initiate such a system.

The Panel endorsed in principle the present version of the guideline, but requested that a number of clarifications be made to certain sections of the text. These included:

- adding and/or amending certain definitions;
- providing a good description of the circumstances of pesticide exposure, and the addition of certain elements to the report of suspected pesticide poisoning cases;
- including a recommendation for mandatory reporting of health and environmental incidents;
- providing more guidance on the verification of incident reports.

The Panel recognized that cases of pesticide poisoning as a result of suicide attempts will have very different policy implications from occupational and accidental cases. However, it recommended that reporting and assessment of suicide cases also be included in the guideline.

The Panel noted that for the guidelines to be effective, many countries will likely need capacity building in various aspects of incident reporting and analysis. The Panel also stressed the need of field-testing this guideline and obtaining feedback about the feasibility of its recommendations and its usefulness, and noted the willingness of individual members and of UNEP to do so. It was underlined that a reporting system is only one of the building blocks in protecting human health and the environment as part of sound pesticide management.

The Panel requested that a definitive draft be circulated to its members for final endorsement by November 2008, and that FAO and WHO, after formatting and editing, proceed with publication of the guideline no later than March 2009.

10.2 Guidelines on registration of pesticides

Based on the outline agreed upon at the previous session of the Panel, a draft of the *Guidelines on Registration of Pesticides* had been prepared. This initial draft had been discussed at the 6th GCDPP Meeting in April 2008, in which most of the members of the Task Team for this guideline participated. The comments and suggestions provided during the meeting were subsequently incorporated in a revised draft, which had been circulated among Panel members and observers.

The Panel was reminded of the fact that the purpose of the guideline is to provide general advice on the principles and process as well as requirements for registration of pesticides, including institutional and administrative organization. It should be considered as an umbrella document with more detailed guidance on technical elements of the registration process (such as data requirements, testing methods or risk assessment procedures) to be provided in separate guidelines.

The Panel expressed its appreciation regarding the advanced status of development of the document. It stressed that an effective pesticide registration system is a vital element for sound management of pesticides in a country, and requires a multi-disciplinary approach in implementation.

The Panel considered that the overall scope and contents of the guideline were appropriate for its purpose, and raised a number of issues that might be considered when finalizing the document. These included:

- limiting the section on the responsibilities of various stakeholders to those that are directly involved in pesticide registration;
- considering to extend the definition of 'pesticide' to the one used by the JMPS, so that public health and domestic use pesticides are more clearly included;
- explaining different types of registration in more detail;
- providing more information on registration by equivalence;
- clarifying and correcting the section on data protection, by limiting it to a description of principles but avoiding to take a specific position, as this was not done in the Code of Conduct;
- ensuring that issues regarding transparency of the registration process and public information are properly covered;
- providing more guidance on the use of existing data and data exchange between registration authorities;
- including experimental permits, and providing more detail on registration options for minor uses and biopesticides;
- providing additional guidance on comparative risk assessment and the substitution principle;
- clarifying the various options and requirements for fast-track registration.

The Panel further confirmed that genetically modified organisms or natural enemies of pests would not be covered by the guideline. It requested FAO and WHO to carry out a legal review of the guideline to avoid inconsistencies or errors.

The Panel recommended to extend the commenting period until 31 December 2008, after which a new draft should prepared and circulated among Panel members for endorsement, no later than March 2009. The Panel requested that, if no major comments are received, FAO and WHO, after formatting and editing, proceed with publication of the guideline.

10.3 Guidelines on pesticide advertising

With respect to the *Guidelines on Pesticide Advertising*, the Panel took note of the new draft which had been prepared by the Task Group chair and the written comments provided on this document.

The draft of the guidelines as presented to the Panel suggests that for certain types of advertisements, the provisions of Article 11.2 do not necessarily need to be observed. This would be the case, for instance, for small promotional items such as pens which may not have enough space to show the required wording. While recognizing that such physical constraints could exist for certain types of promotional items, the Panel underlined that no exemptions should be made in this guideline for provisions in the Code of Conduct. Therefore, the Panel recommended that the provisions of Article 11 in the Code of Conduct would need to apply to all forms of pesticide advertising, and that the guidelines reflect this clearly.

The Panel discussed the need to provide further guidance on Article 11.2.18 of the Code of Conduct which states that *Pesticide industry should ensure that advertisements and promotional activities should not include inappropriate incentives to encourage the purchase of pesticides*. The previous session of the Panel recommended that examples be given of what can be considered appropriate and inappropriate incentives or gifts, to assist regulators in the application of this article to their national situation. Examples were subsequently provided in the new draft of the guideline.

The draft guidelines provide a general definition of 'inappropriate' which reads: *In general terms, an incentive may be considered appropriate if it is in line with the objectives of the Code of Conduct, and inappropriate if it runs counter to these objectives, i.e. if it encourages the purchasing of a pesticide for another reason than to make the best choice to control a pest or disease*. This definition was considered by some observers as too narrow, as the 'best choice' could be interpreted as being limited to biological reasons, but excluding convenience of use, price, etc. Such an interpretation would then disallow advertising to encourage 'brand change'. It was suggested to modify the latter part of the phrase into: *make the best choice for cost-effective control a pest or disease.* However, the Panel considered this an equally narrow interpretation, and suggested clarify that the best choice will need to be made for agronomic, economic, environmental and health reasons.

Concern was expressed about the use of specific examples in the guidelines, as they can never be exhaustive, and are highly dependent on social, economic, cultural and religious circumstances. A replacement text was therefore presented to the Panel of a more generic nature. The Panel discussed both the draft guideline text and the proposed replacement and concluded that inclusion in the guidelines of explicit examples of inappropriate incentives

would be helpful to national regulators. It considered that the draft guideline clearly stresses that the exact interpretation of this article is subjected to the national or local situation.

The Panel therefore concluded that a list of examples of inappropriate (but not of appropriate) incentives of gifts should be provided in the guideline, such as, but not necessarily limited to:

- incentives or gifts which are not related to the product advertised;
- incentives or gifts with a value higher than the product advertised, unless it is related to the judicious use of the product in question (e.g., personal protective equipment, sprayer maintenance equipment);
- incentives or gifts in exchange of the product label, as this leads to unlabeled products in the hands of the end-user.

The suggestion made to refer in the guidelines to the International Chamber of Commerce (ICC) Code of Advertising and Marketing Communication Practice[23] (and in particular Chapter A on Sales promotion) as minimum general provisions regarding the use of incentives, was supported by the Panel.

The guideline leaves it at the discretion of governments and other stakeholders to notify FAO or WHO of cases of non observance of the provisions of the Code of Conduct on advertising. FAO and WHO may decide to review such notifications. It was suggested that a summary of such complaints and the outcome of the review should be made publicly available by FAO or WHO. The Panel did not support this suggestion, since the *ad hoc* monitoring procedure of observance of the Code of Conduct, set up by FAO, is not a formal international complaints procedure[24.]

CropLife International noted that, at this point in time, it could not agree with the Panel recommendations on this guideline, but would provide a definitive statement on its acceptance after having reviewed the final draft.

The Task Group was requested to incorporate the recommendations made during the meeting, as well as any editorial comments as far as appropriate. The Panel further requested that the final draft of the guidelines be reviewed again for any legal inconsistencies.

The Panel recommended that the Task Group prepare a new draft of the document by January 2009, for subsequent circulation among the Panel members for endorsement. The Panel requested that, if no major comments are received, FAO and WHO, after formatting and editing, proceed with publication of the guideline no later than June 2009.

[23] http://www.iccwbo.org/policy/marketing/id8532/index.html

[24] http://www.fao.org/ag/AGP/AGPP/Pesticid/Code/Guidelines/Monitoring.htm

11. Guidelines proposed for updating

The Panel discussed two guidelines which had been proposed for updating during a previous session.

11.1 Guidelines on pesticide legislation

The Panel was presented with the recently published *FAO Legislative Study on Designing National Pesticide Legislation,* and commended its quality and clarity.

The Panel underlined that the existing FAO guidelines on pesticide legislation are outdated and do not cover all pesticide uses addressed in the Code of Conduct, and reiterated its previous recommendation to develop updated guidelines on this issue. The Panel discussed in which ways the presented legislative study could be used as a basis for the elaboration of a new guideline on pesticide legislation, which would need to cover all areas of pesticide use, including public health and domestic uses.

The Panel recommended that FAO and WHO initiate the development of an outline for a new guideline on pesticide legislation, to be presented for consideration by the Panel at its next session.

11.2 Guidelines on good labelling practice for pesticides

The Panel was informed that no progress had yet been made in updating this document. The Panel stressed the importance of effective labelling of pesticides as a prime tool for communication with the user.

The Panel revisited its previous recommendation to present the WHO and GHS classifications for pesticides in a parallel manner in the guidelines, since these two systems had not yet been harmonized. It agreed, however, that clear advice on pesticide labelling needs to be provided to countries and a double-track system should be avoided. Furthermore, countries have started implementing GHS and require specific guidance on how to apply this to pesticide labelling.

The Panel noted that while the GHS is to become the global standard for classification and labelling of chemicals, the FAO guidelines and WHO classification of pesticides have long history of use in many countries, and that users have grown accustomed to this approach. The Panel therefore supported the proposal to update the guideline, taking into account the GHS but ensuring that the existing guideline is not changed more than absolutely necessary.

The Panel requested that a first draft be circulated among Panel members and observers by January 2009.

12. Implementation of the Code of Conduct

Although a large number of activities are being carried out by international organizations, national governments, the private sector and civil society organizations, which contribute to the implementation of the Code of Conduct, continued efforts to promote the sound management of pesticides are still needed, in particular in developing countries and countries with economies in transition. The Panel was therefore invited to discuss ways and means of strengthening implementation of the Code over the next few years.

A number of issues were put forward, regarding a possibly reorientation of implementation of the Code, among them:

- increased focus on national implementation, by favouring the development of national projects and programmes;
- better orientation of guidance and guidelines to the needs to developing countries and including systematic verification of their usefulness;
- closer integration of pest management, pesticide management, sustainable intensification of crop production, integrated vector management, chemicals management, environmental issues;
- mainstreaming of awareness building on the Code in the regular work of FAO, WHO and UNEP.

It was proposed to develop a programme for implementation of the Code of Conduct, which would build on a strategic approach based on four main elements: **i.** *normative work* at the international level (e.g., guidelines, policies, forums), which would guide to **ii.** *capacity building* on technical and policy issues (e.g., training, information exchange) at national and regional levels, which would lead to **iii.** *implementation* projects and programmes, primarily at the national level, which in turn would require **iv.** *feedback* mechanisms to assess effectiveness of implementation. By having the feedback direct the normative work again, a 'strategic loop' for implementation of the Code of Conduct could be developed.

The Panel welcomed the initiative to attempt to increase attention and resources for implementation of the Code of Conduct, and agreed that activities at national and regional levels are in particular required. The Panel endorsed the general concept to develop a programme for implementation of the Code of Conduct along the lines set out during the meeting.

The Panel stressed the importance of ensuring the involvement of all stakeholders, since the success of the Code of Conduct is borne by the fact that all major stakeholders have underwritten it. New stakeholders, such as the food sector, should therefore be actively engaged to participate in the programme. Furthermore, the Panel recommended that opportunities be sought to work with other organizations which are members of the Inter-organization Programme for the Sound Management of Chemicals (IOMC) to strengthen work on training, capacity building and implementation of the Code of Conduct.

The Panel stressed the importance of integration of the programme with initiatives such as the *Strategic Approach to International Chemicals Management* (SAICM) and the *2nd International Conference on Chemicals Management* (ICCM-2), with a view to facilitating a more effective implementation of the Code of Conduct.

While FAO, WHO and UNEP are already accessing their regular budgets to fund implementation activities, this will certainly be greatly insufficient to develop an effective programme. The Panel therefore called upon FAO, WHO, UNEP and other meeting participants to identify sources and secure funds for implementation of the programme. The Panel recommended that particular attention be paid to presenting the programme in ways that are attractive to governments and potential donors.

The Panel indicated that its members could contribute to the development of a programme for implementation of the Code of Conduct by identifying important needs and gaps that require attention and key entry points that could help get such a programme started up. Furthermore, the Panel could act as 'steering committee' which would oversee implementation and monitor its effectiveness.

13. Counterfeit pesticides

At the request of CropLife International, the Panel discussed the problem of counterfeit and illegal pesticides.

The Panel was informed of the increasing importance of counterfeit pesticide products, which are estimated to amount to 5-7 percent of the products in Europe and 20-30 percent in developing countries. Apart from causing economic losses to the legitimate pesticide industry, forged pesticides may endanger farmers' livelihoods and health, put the food chain and consumers at risk, and may cause damage to the environment. Counterfeiting also undermines the national regulatory systems. CropLife expressed its concern that legitimate pesticides tend to be strictly regulated but problems of illegal and counterfeit products still get relatively limited attention in many countries.

The Panel recognized the importance of the problems caused by the trade in counterfeit pesticides, and noted that it appears to be related, to a large extent, to weak inspection and control systems in many (developing) countries. Strengthening import and export controls, and developing effective systems of quality control which are also feasible in resource-poor countries, are needed to get to grips with this problem. This will require involvement of many players and stakeholders.

The Panel indicated that it would like to further discuss possible ways of reducing the trade and adverse impact of counterfeit pesticides at a next session.

14. Review of the Code of Conduct

The Panel discussed the scope and objectives of the *International Code of Conduct on the Distribution and Use of Pesticides,* in particular its coverage of public health and domestic pesticides. The Panel noted that the Code of Conduct clearly addresses all pesticides and all areas of use. However, it was recognized that its provisions, definitions and the included references appear to focus more on the management of agricultural pesticides.

The Panel recognized that an even more complete Code of Conduct, which might be jointly published by FAO, WHO and possibly UNEP, would likely increase its visibility and impact. However, concern was expressed at initiating a formal revision of the Code of Conduct, as experience has shown that this would require much time and resources, which might better be used for actual implementation of the Code of Conduct. Any possible updating of the Code of Conduct should therefore be limited in scope and not attempt to amend issues expected to generate much discussion.

The Panel recommended that FAO and WHO start the process to ensure that the Code of Conduct, and its implementation tools, adequately addresses all pesticides, and in particular public health pesticides. As a first step, WHO was requested to prepare a working document indicating which articles of the Code of Conduct might need to be amended or completed to ensure full coverage of public health and domestic pesticides.

15. Recommendations

Based on the working documents reviewed, the presentations made and the discussions held during the meeting, the Panel made the following recommendations:

Highly hazardous pesticides

1. To make further progress on the initiative for the reduction of risks posed by HHPs, the Panel reviewed the recommendations from its 2007 meeting and **agreed** that these recommendations **be adopted with the modifications** as incorporated in the following text:

2. HHPs **should be defined** as having one or more of the following characteristics:

   - pesticide formulations that meet the criteria of classes Ia or Ib of the *WHO Recommended Classification of Pesticides by Hazard*;

   or

   - pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

   or

- pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

or

- pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the *Globally Harmonized System on Classification and Labelling of Chemicals* (GHS);

or

- pesticide active ingredients listed by the *Stockholm Convention* in its Annexes A and B, and those meeting all the criteria in paragraph 1 of annex D of the Convention;

or

- pesticide active ingredients and formulations listed by the *Rotterdam Convention* in its Annex III;

or

- pesticides listed under the *Montreal Protocol*;

or

- pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

3. The Panel **noted** advancements in the development of harmonized testing guidelines and evaluation criteria for endocrine disrupting chemicals, but felt it was premature to include specific reference to endocrine disruptors as a separate category of highly hazardous pesticides. However, the Panel **recognized** that endocrine disruption can be an important mechanism of pesticide hazard expression. It was **recommended** that the extent to which the existing criteria address endocrine disrupting pesticides be reviewed by the Panel at one of its next sessions.

4. The Panel further **recommended** that WHO, FAO and UNEP develop criteria for determining whether pesticide active ingredients and their formulations have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

5. The Panel discussed how to address the current use of highly hazardous pesticides, and **recommended** that these should not be registered for use unless:

   a) governments establish a clear need;

   b) no alternatives, based on a risk – benefit analysis, are available; and

   c) control measures as well as good marketing practices are sufficient to ensure that the product can be handled with acceptable risk to human health and the environment.

6. The Panel discussed priority activities related to risk reduction from HHPs, including a progressive ban, and **recommended** that:

   a) FAO and WHO, as a first step, make available to countries information on HHPs based on the criteria above, update it periodically in cooperation with UNEP, and make it widely known;

b) FAO, in collaboration with WHO, invite governments and the pesticide industry to develop plans of action to reduce risks from HHPs by taking regulatory or technical action, either at the national or the regional level as appropriate, taking into account the work undertaken in existing Multilateral Environmental Agreements such as the Stockholm Convention, Rotterdam Convention and the Montreal Protocol;

c) FAO, in collaboration with WHO, collect information on alternatives for HHPs, both reduced risk pesticides and other pest management approaches, in cooperation with all relevant stakeholders, and share experiences among countries;

d) FAO, in collaboration with WHO, seek assistance from donors for countries which wish to act to reduce risks from HHPs with the aim of preparing, implementing and enforcing action plans and search for alternatives;

e) FAO mobilize internal and external resources in order to implement, as a priority, the recommendations of the FAO Council with respect to HHPs.

7. The Panel further **recommended** that FAO, in collaboration with WHO, invite national governments to ensure that at least the following risk reduction measures for highly hazardous pesticides (HHPs) are taken into account:

a) identify HHPs with help of the criteria explained above;

b) review the need for the use of HHPs, while simultaneously reviewing use conditions, mitigation measures and comparative risk assessment;

c) where a specific need is identified for a HHP and no viable alternatives are available, governments should be advised to take all the necessary precautions, mitigation measures and apply restrictions, that may include the use only under certain conditions or by specifically certified users, severe restrictions, or a possible phase-out;

d) promote the use of alternative pest management strategies and, in case they are not available, promote research for development of alternative strategies;

e) promote the substitution principle for HHPs;

f) ensure the provision of sufficient advice and information to users.

WHO Classification of pesticides by hazard

8. Given the great importance of the *WHO Recommended Classification of Pesticides by Hazard* for various aspects of pesticide management and regulation, including registration, classification and labelling, in particular in many developing countries, the Panel **expressed its concern** that that the classifications of the WHO system and of the GHS have not yet been harmonized, which impedes the provision of clear guidance on classification and labelling of pesticides.

9. The Panel therefore **recommended** that WHO, as a matter of urgency, harmonize its criteria on acute toxicity with those of the GHS. The Panel further **recommended** that WHO assess the feasibility to incorporate the GHS criteria on carcinogenicity, mutagenicity and reproductive toxicity, and other relevant endpoints, into its Classification and ensure that all pesticides listed have been evaluated against these criteria.

Implementation of the Code of Conduct

10. The Panel discussed the need to strengthen the implementation of the *International Code of Conduct on the Distribution and Use of Pesticides* and **recognized** the importance of its implementation at, in particular, national and regional levels. The Panel **endorsed** the general concept to develop a programme for implementation of the Code of Conduct as presented, and **recommended** that it include a strategy to involve the food sector as an important stakeholder.

11. The Panel **stressed** the importance of integration with initiatives such as the *Strategic Approach to International Chemicals Management* (SAICM) and the *2nd International Conference on Chemicals Management* (ICCM-2), with a view to facilitating a more effective implementation of the Code of Conduct. Furthermore, the Panel **recommended** that opportunities be sought to work with organizations which are members of the Inter-organization Programme for the Sound Management of Chemicals (IOMC) to strengthen work on training, capacity building and implementation of the Code of Conduct.

12. The Panel **called upon** FAO, WHO, UNEP and other meeting participants to identify sources and secure funds for implementation of the programme. The Panel **recommended** that particular attention be paid to presenting the programme in ways that are attractive to governments and potential donors.

13. The Panel **requested** to be kept informed of developments in the elaboration and implementation of the programme.

Guidelines in support of the Code of Conduct

14. The Panel reviewed the drafting status of a number of guidelines which are being developed in support of the Code of Conduct, and made the following recommendations.

    a) With respect to the *Guidelines on Resistance Management for Pesticides*, the Panel took note of the ongoing work to develop a new draft of this guideline, along the lines set out during its previous session. The Panel **requested** the Task Group chair and the drafter to finalize the draft by January 2009, to be circulated for review by the full Task Group and independent peer reviewers. The Panel **recommended** that comments received be taken into account in finalizing this draft, and that it subsequently be circulated among Panel members and observers for review, by June 2009. A final version of the guideline should be presented to the Panel for endorsement by October 2009.

    b) With respect to the *Guidelines on Registration of Microbial Pest Control Agents*, the Panel took note of the fact that a draft had been prepared for this document, based on the outline agreed during its previous session. The Panel **requested** that this draft be finalized and reviewed by the Task Group by January 2009, and subsequently be sent for external peer review. The Panel **recommended** that the peer review be taken into account in finalizing this draft, and it be circulated subsequently among Panel members and observers for comments, by May 2009. A new version of the guideline should be presented to the Panel for endorsement, by October 2009.

c) With respect to the *Guidance on Pest and Pesticide Management Policy Development*, the Panel noted the status of development of this draft and **requested** that, after internal review by FAO, the draft be circulated and commented on by the Task Group, by January 2009, to assess whether previous comments have been incorporated in an acceptable manner. The Panel **recommended** that the Task Group consider calling an external independent peer review of the guidance document if certain elements would remain unresolved. The Panel **recommended** that a final draft be circulated among Panel members for endorsement by June 2009 and that FAO, if no major comments were received, finalize the guidance document and subsequently proceed with publication prior to its next session.

15. The Panel reviewed the draft outline of one guideline which is being developed in support of the Code of Conduct, and made the following recommendations.

a) With respect to the outline for the *Guidelines on Retail Establishments for Pesticides*, the Panel **underlined** the importance of proper regulation of retail outlets, and **recommended** drafting a guideline focused on providing advice to the governments in the establishment of a proper system of sale of pesticides within the country, including public health and household pesticides. The Panel **provided** several **suggestions** on its content, which included taking into account different types of retail establishments which may sell pesticides; addressing in sufficient detail elements on labelling, packaging, storage and disposal; and stressing the need to avoid food contamination during storage. The Panel **requested** that FAO and WHO prepare a detailed annotated table of contents for this guideline by March 2009, and circulate it among Panel members and observers for comments. The Panel further **recommended** that the development of the guideline be initiated as soon as possible afterwards, so that a complete draft can be distributed for discussion at its next Session.

16. The Panel reviewed a number of draft guidelines that were developed in support of the Code of Conduct, and made the following recommendations.

a) With respect to the *Guidelines on the Development of a Reporting System for Health and Environmental Incidents Resulting from Exposure to Pesticides*, the Panel **recognized** the importance of having a feedback system on possible adverse impact of pesticides within the country as a basis for effective interventions through policy and other options. The Panel **endorsed in principle** the present version of the guideline, but requested that a number of clarifications be made to certain sections of the text. The Panel **requested** that a definitive draft be circulated to its members for final endorsement by November 2008, and that FAO and WHO, after formatting and editing, proceed with publication of the guideline no later than March 2009.

b) With respect to the *Guidelines on Registration of Pesticides*, the Panel **stressed** that an effective pesticide registration system is a vital element for sound management of pesticides in a country, and requires a multi-disciplinary approach in implementation. The Panel **made suggestions** for improvements to various sections of the draft, including the responsibilities of various actors for pesticide registration; the issue of data protection, transparency and public information; registration by equivalence; comparative risk assessment and the substitution principle. The Panel **recommended** to extend the commenting period until 31 December 2008, after

which a new draft should prepared and circulated among Panel members for endorsement, no later than March 2009. The Panel **requested** that, if no major comments are received, FAO and WHO, after formatting and editing, proceed with publication of the guideline.

c) With respect to the *Guidelines on Pesticide Advertising*, the Panel took note of the new draft which had been prepared by the Task Group chair and the comments provided on this document. The Panel **recommended** that the provisions of Article 11 in the Code would need to apply to all forms of advertising. The Panel further discussed the issue of inappropriate incentives and **concluded** that a list of examples should be provided in the guideline, taking into account the comments made. The Panel **recommended** that the Task Group prepare a new draft of the document by January 2009, for subsequent circulation by among the Panel members for endorsement. The Panel **requested** that, if no major comments are received, FAO and WHO, after formatting and editing, proceed with publication of the guideline no later than June 2009.

17. The Panel reviewed a number of draft guidelines which had been proposed for updating, and made the following recommendations.

a) With respect to *Guidelines on Pesticide Legislation*, the Panel took note of the *FAO Legislative Study on Designing National Pesticide Legislation* and **commended** its quality. The Panel **underlined** that existing FAO guidelines on pesticide legislation are outdated and do not cover all pesticide uses addressed in the Code of Conduct. The Panel discussed in which ways the study could be used as a basis for the elaboration of a new guideline on pesticide legislation, covering all areas of pesticide use, including public health and domestic uses. The Panel **recommended** that FAO and WHO initiate the development of an outline for a new guideline on pesticide legislation, to be presented for consideration by the Panel at its next session.

b) With respect to the Guidelines *on Good Labelling Practice for Pesticides*, the Panel took note of the status of updating this document. The Panel **stressed** the importance of effective labelling of pesticides as a prime tool for communication with the user. The Panel **agreed** that clear advice on labelling needs to be provided to countries, and that parallel presentations of the WHO and GHS classifications for pesticides in the same guideline should be avoided. The Panel **recommended** that the guideline be updated, taking into account the GHS but ensuring that the existing guideline is not changed more than absolutely necessary, and that a first draft be circulated among Panel members and observers by January 2009.

Review of Code of Conduct

18. The Panel discussed the scope and objectives of the *International Code of Conduct on the Distribution and Use of Pesticides* and **noted** that, while these clearly address all pesticides, the provisions of the Code of Conduct and the included references appear to lean to the management of agricultural pesticides. The Panel therefore **recommended** that FAO and WHO start the process to ensure that the Code of Conduct, and its

implementation tools, adequately addresses all pesticides, and in particular public health pesticides.

16. Closure of the meeting

The 2nd FAO/WHO Joint Meeting on Pesticide Management, and the 4th Session of the FAO Panel of Experts on Pesticide Management, was closed by Mr Mark Davis, Senior Officer a.i. of the Pesticide Management Group of FAO and by Dr Morteza Zaim, Scientist in charge of the WHO Pesticide Evaluation Scheme. They thanked all participants for their valuable inputs in the discussions and expressed their satisfaction about the progress that was made.

The meeting was informed that Dr Vibeke Bernson, who had chaired the meeting over the last few years, would be retiring at the end of 2008. Her pleasant but very efficient way of chairing the meetings has greatly contributed to their success. Her contribution to the Panel was gratefully acknowledged.

Finally, the meeting also took note of the fact that FAO Panel members will come to the end of their 4-year term in the course of 2009, but before the next session. Therefore, Mr Davis extended his sincere gratitude, on behalf of FAO, to all for having accepted to sit on the Panel and for having shared their experience and expertise. He presented an FAO memorial medal to each FAO Panel member as an expression of the appreciation of the Organization.

Annex 1 – List of participants

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Annex 2 – Agenda

1. Opening of the meeting and welcome address

2. Appointment of Chairman and Rapporteurs

3. Adoption of agenda

4. Introduction of meeting procedure, working arrangements and housekeeping matters.

5. Summary of developments and actions taken after the first joint meeting in October 2007.

6. Highly hazardous pesticides – status of implementation of recommendations made after the first joint meeting in October 2007.

7. Draft Guidelines agreed for publication in the previous meeting – status report
   a. Guidelines on management options for empty pesticide containers.
   b. Guidelines on pesticide advertising.
   c. Guidance on pest and pesticide management policy development – agriculture.

8. Draft Guidelines under development – status report
   a. Guidelines on resistance management for pesticides.
   b. Guidelines on registration microbial pest control agents.

9. Draft outlines for Guidelines – for review
   a. Guidelines on retail establishments of pesticides.

10. Draft Guidelines – for review.
    a. Guidelines on the development a reporting system for health and environmental incidents resulting from exposure to pesticides.
    b. Guidelines on registration of pesticides.

11. Guidelines proposed for updating – issues regarding content
    a. Guidelines on pesticide legislation
    b. Guidelines on good labelling practice for pesticides

12. Implementation of the revised version of the International Code of Conduct – future orientation of activities.

13. Any other matters.

Hazards of pesticides imported into Mozambique, 2002-2011

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Contents

Summary

Together with the government of Mozambique, The Food and Agriculture of the United Nations (FAO) is implementing a project to identify the most Highly Hazardous Pesticides (HHPs) in Mozambique based on import data and to reduce risks of these pesticides by recommendations for mitigation measures. In the framework of this project Alterra, Wageningen UR, has conducted a desk top study to assess the hazards associated with pesticides imported in Mozambique from 2002 to 2011. The objectives of the study were (1) to conduct an evaluation of historical trends in the use of pesticides in Mozambique based on pesticide import data compiled by the Ministry of Agriculture over the period 2002 – 2011, (2) to assess trends in human health and environmental hazards and potential risks of the pesticides imported in Mozambique, and (3) to identify pesticides or pesticide use patterns (as far as feasible) contributing most to these hazards.

In order to analyse trends in potential hazards of pesticide use on human health and the environment, hazard based indicators were used for occupational health, aquatic organisms, bees and groundwater. When true exposure assessment data are not available, hazard based indicators can be used to rank pesticides relatively to each other from high to low hazard. FAO supplied data to Alterra of pesticides imported into Mozambique from the years 2002 to 2011, as well as information on pesticides with a registration in Mozambique. It is not clear if the pesticide import data for 2002 used in this study are complete.

The most important results of the study are:

- The volume of pesticides imported increased almost threefold, from 670 tonnes in 2003 to 2592 tonnes in 2011. Agricultural production increased by 40 % from 9.9 million tonnes in 2002 to 13,9 million tonnes in 2011, whereas the agricultural area increased only by 1.4%;
- The types of pesticides imported in the country are very consistent over time. The majority of products consists of insecticides, followed by the herbicides and fungicides;
- The volume of highly hazardous products imported over time decreased and the volume of products with a (very) low hazard increased;
- Only few pesticide products with a known chronic hazard to human health were imported in the country, although carcinogenic products were imported at the rate of 100 tons per year;
- A considerable number of the pesticides imported into the country are acutely toxic to fish, aquatic invertebrates, algae and bees. However, the less hazardous pesticides represent a much higher volume of imports;
- The Environmental Toxic Load (ETL) (relative hazard corrected for surface of agricultural area) to aquatic organisms (fish, aquatic invertebrates and algae) increases from 2002 to 2010, but decreases for all three groups of species in 2011;
- Overall, the hazard of the imported pesticides is more than two times higher to aquatic invertebrates and algae than to fish;
- The ETL to bees also increases from 2002 to 2008, but is considerably lower from 2009 to 2011;
- Only few active ingredients with a very high or high leaching potential are imported in the country.

The pesticides that contributed most to the overall human health hazards and environmental hazards are given in the following table. Active ingredients of primary or secondary concern were identified using criteria that combine both potential hazard of the pesticides and imported quantities in Mozambique. The table may be used to focus hazard reducing measures in the country.

Pesticides imported in Mozambique from 2002 to 2011 that are of concern in terms of potential human health and environmental hazard and annually imported quantity.

Type of hazard	Pesticide active ingredient of primary concern	Pesticide active ingredient of secondary concern
Human health		
Acute (WHO classification)	Class I pesticide products containing: Abamectin Aldicarb Aluminium phoshide Fenamiphos Methomyl Mevinphos Monocrotophos Oxamyl Terbufos	Class II pesticide products containing: Ametryn DDT Lambda-cyhalothrin
Chronic	Diuron (carcinogenic) Mancozeb (carcinogenic)	Dichlorvos (carcinogenic)
Environment		
Fish	Lambda-cyhalothrin	Aluminium phoshide Chlorpyrifos Cyfluthrin Cypermethrin Endosulfan
Aquatic invertebrates	-	Chlorpyrifos Cypermethrin DDT Dichlorvos Ethion Fenvalerate Lambda-cyhalothrin Pirimiphos-methyl
Algae	Acetochlor	Ametryn Paraquat
Bees	Imidacloprid	Bendiocarb Chlorpyrifos Cyfluthrin Cypermethrin Deltamethrin Lambda-cyhalothrin Profenofos Thiamethoxam
Leaching to groundwater	Methyl bromide Tebuthiuron	Atrazine Clomazone Hexazione Imidacloprid Propoxur

1 Introduction

1.1 Scope of the project

Together with the government of Mozambique, The Food and Agriculture of the United Nations (FAO) has been implementaing a project to identify the most Highly Hazardous Pesticides (HHPs) in Mozambique and to reduce risks of these pesticides by recommendations for mitigation measures.

In the framework of this project Alterra, Wageningen UR, has conducted a desk top study of the hazards associated with pesticides imported in Mozambique from 2002 to 2011.

1.2 Objectives

The objectives of the study were:

1. to conduct an evaluation of historical trends in the use of pesticides in Mozambique based on pesticide import data compiled by the Ministry of Agriculture over the period 2002 – 2011,
2. to assess trends in human health and environmental hazards and potential risks of the pesticides imported in Mozambique, and
3. to identify pesticides or pesticide use patterns (as far as feasible) contributing most to these hazards.

1.3 Approach

The potential risk related to the use of a specific pesticide is always determined by pesticide properties (hazard) and circumstances in which the pesticide is used (exposure). Therefore:

Risk = hazard × exposure

Hazard is determined by the toxicological properties of the pesticide. Environmental exposure is determined by pesticide use patterns, the physico-chemical properties of the active ingredient (a.i.) and the properties of the environment (e.g. soil, climate, surface water) of concern. Human occupational exposure is further determined by use of personal protective equipment, application equipment, skills and awareness of the operator, while dietary exposure is determined by many other factors like for instance composition of diet.

In order to analyse trends in potential hazards of pesticide use on human health and the environment, we used hazard based indicators for occupational health, aquatic organisms, bees and groundwater. When real exposure assessment data are not available, hazard based indicators can be used to rank pesticides relatively to each other from high to low hazard. These indicators, together with the quantitative information on pesticides use, can provide an indication of which pesticides are most likely to pose a potential problem. Such an approach has earlier been successful in identifying the trends in the hazards of pesticides used in cotton in different countries (De Blécourt et al., 2010). The actual risks posed by these pesticides, however, remain uncertain as realistic exposure profiles are not explicitly taken into consideration. This would need more location-specific data. But while perhaps less specific than risk indicators due to the lack of exposure data, hazard indicators are quite suitable for trend assessments and ranking exercises.

2 Methods

2.1 Datasets

FAO has supplied data to Alterra of pesticides imported into Mozambique from the years 2002 to 2011, as well as information on pesticides with a registration in Mozambique. Hereafter these spreadsheet files will be referred to as the Import data and the Registered pesticide data, respectively. Following an initial quality check conducted by Alterra, additional efforts by FAO and Alterra were needed in order to enhance the quality of these data, notably the Import data.

2.1.1 Import data

Text fields in the original Excel spreadsheet with Import data delivered by FAO contain Product names, Active ingredient names, Categories (i.e. the product group), Importer names, Units of Concentration, Units of Quantity, and the Monetary Units. These text fields were screened for typing errors, alternative spelling, abbreviations, etc.

Inconsistent entries were corrected when possible. Those which could not be corrected were removed from the dataset. For example, the active ingredient content is required for conversion of product volumes into active ingredient volumes. The import data included 11 bio pesticides and inorganic pesticides with an unknown formulation (i.e. a blank) or a value out of range in the content field. These import events had to be removed. In another five cases, a missing value for the content was replaced with the mean value of the content in the other imported products with exactly the same active ingredients. A numerical field was added to the text fields for identification. In some cases the number in the Concentration a.i. field was corrected in order to obtain a unique value for the content of the active ingredient of a formulated product

2.1.2 Pesticide properties

In order to make an analysis of the human and environmental hazards related to the agricultural use of pesticides in Mozambique, full consistency is required between the product formulation in the Import data and the active ingredients in the Registered pesticide data. On a few occasions, when the information in both datasets did not entirely match, we let the Import data prevail over the Registered pesticide data.

We gathered the toxicity and fate properties of the active ingredients and the products mentioned in the Import data from the following sources:

1. The Registered pesticide data, mainly for human toxicity data.
2. The internal compound database of the Alterra team Ecological Risk Assessment (ERA). This internal database is used for projects only and was last updated for the study on cotton (see De Blécourt *et al.*, 2010).
3. A compound database available from the evaluation of the Dutch policy plan for sustainable use of pesticides (mainly for fate properties).
4. The Pesticides Properties DataBase PPDB (Footprint; 2013, 2007) database, for the classification of physical properties and environmental toxicity.

Some 80% of the properties required for the analysis were found in these sources. We used a routine for the repacement of missing values for compound properties, which consists of the following steps:

- When a parameter value for an active ingredient is not available, the mean value of all active ingredients from the same chemical class will be used (e.g., carbamate, organophosphate).

- When the mean of the parameter values for the active ingredients from the same chemical class cannot be calculated, the mean of all active ingredients from the same product group is used (insecticides, fungicides, etc.).
- When no mean values can be calculated, the parameter value is classified as unknown.

Accordingly, the status of each property will be either 1) original value, 2) estimated value based on chemical class, 3) estimated value based on product group, or 4) not available. This routine was developed in the framework of the European HAIR project on risk indicators for agricultural use of pesticides (Kruijne *et al*., 2011). It was developed and approved by the scientists in the HAIR consortium, but is has so far not been validated.

Annex 1 contains the fate properties and toxicity values for all active ingredients, including the source.

2.2 Trends in pesticide import

Trends in pesticide import in Mozambique from 2002 to 2011 were explored in terms of numbers (type) of pesticides and volume (amount) of pesticides. Trends in imported pesticide products and their active ingredients were based on the annual volume imported and the formulation of these products. Metabolites are not considered in this study.

In reality, the annual volume of products used in agricultural crops in the country may be different from the volume imported due to changes in stocks, exports to other countries, and non-agricultural uses. Gathering information on these flows and stocks was beyond the scope of this study. Moreover, the Import data or Registered pesticide data did not contain information on their use in e.g. agriculture, public health or veterinary use, so no formal distinction can be made. The import data provided are regarded as a proxy for actual use in Mozambique in the different sectors combined.

2.3 Hazard indicators

Hazard based indicators were used to rank products and active ingredients relative to each other from high to low hazard. Hazard is defined by the OECD (2003) as 'an inherent property of an agent or situation having the potential to cause adverse effects when an organism, system or (sub) population is exposed to that agent'. Hazard is determined by the toxicological properties of the formulated pesticide or its active ingredients. The hazard assessments conducted in this study do not estimate the actual risks in the field since true risks depend on many more factors that are not explicitly taken into account here such as pesticide formulation, soil properties, weather conditions during application, use of protective personal equipment, method of application, buffer strips and other mitigation techniques, the species that do actually occur in the field, etc.

In this study hazard assessments were performed for: 1) acute hazard to human health (WHO hazard classification), 2) chronic hazard to human health (carcinogenicity, mutagenicity and effects on reproduction), 3) hazard to aquatic organisms (fish, *Daphnia,* and algae), 4) hazard to bees, and 5) groundwater leaching potential. The basis of the indicators is described more fully below.

2.3.1 Acute hazard to human health

The classification of active ingredients according to their acute toxicity to human health originated from 'The World Health Organization recommended classification of pesticides by Hazard' (WHO, 2010). The hazard referred to is the acute hazard to health (that is, the potential effects of single or multiple exposures over a relatively short period of time) that might be encountered accidentally by any person handling the product in accordance with the directions for handling by the manufacturer or in accordance with the rules laid down for storage and transportation by competent international bodies. This definition does not include the regular handling of products in developing countries without personal protection equipment and consequent exposure.

The classification is primarily based on data on the acute oral and dermal toxicity to rats as standard testing species. Since 2009 it does not distinguish anymore between solid and liquid formulations. Provision is made for the classification of a particular compound to be adjusted if, for any reasons, the acute hazard to man differs from that indicated by the LD50 assessments alone. The WHO classification takes into consideration the toxicity of the technical compound and its common formulations. The criteria for classification are shown in Table 1.

Table 1: Categories of acute toxicity to human health according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) used for classification of formulations (WHO, 2010).

WHO Class		$LD50_P$ (mg/kg body weight)	
		Oral	Dermal
Ia	Extremely hazardous	< 5	< 50
Ib	Highly hazardous	5-50	50-200
II	Moderately hazardous	50-2000	200-2000
III	Slightly hazardous	2000-5000	2000-5000
U	Unlikely to present acute hazard	5000 or higher	

The classification of any product depends on the formulation concentration. If the concentration of the formulation is low, this may decrease the exposure and thus the acute risk (Equations 1, 2). Furthermore, for a solid formulation the exposure is usually lower compared to a liquid formulation since it is more difficult for a solid to pass through the skin.

Products containing a single active ingredient are classified based on the proportional toxicity and the categories shown in Table 1.

$$LD50_P = \frac{LD50_{ai}}{f_{ai}} \qquad \text{Eq. 1}$$

$LD50_P$ proportional LD50 for the product formulation (mg/kg body weight)
$LD50_{ai}$ oral acute LD50 or dermal acute LD50 of the active ingredient (mg/kg body weight)
f_{ai} content of the active ingredient (fraction)

Mixtures, i.e. products containing multiple active ingredients, are classified according to

$$LD50_P = \frac{1}{\sum \frac{f_{ai}}{LD50_{ai}}} \qquad \text{Eq. 2}$$

using the categories for oral toxicity shown in Table 1.

According to the WHO (2010), if both the oral acute LD50 and the dermal acute LD50 are available, the product should be classified based on the acute toxicity which results in the highest hazard class. The fields used for LD50 values in the Registered pesticide data were not entirely internally consistent. Fields contained numbers with both decimal points and comma's, text characters instead of numbers, combinations of both, lower limits, ranges, blanks and colours. This was too cumbersome to straighten out for 200 active ingredients in some 450 products. Numerical toxicity data were therefore partly gathered from the other sources used (see Annex 1). For practical reasons we decided only to use oral toxicity data. Oral LD50 data were more suitable to deal with the classification of mixtures. Often, there were no dermal data for all active ingredients in a mixture. Formulated mixtures of pesticides

cannot be classified on combined oral and dermal data (WHO, 2010). Moreover, the availability of dermal toxicity data is limited compared to oral toxicity, a fact that is recognised by the WHO (2010).

The consequence is that the oral toxicity criteria for classes Ia, Ib and II are slightly less strict than for purely dermal data. But oral toxicity is often higher than dermal toxicity, so in the majority of cases the use of oral toxicity data will lead to the most conservative classification. Another advantage is that all formulated pesticides are classified in a uniform way.

2.3.2 Chronic hazard to human health

According to the explanation provided with the HHP data, the classification of active ingredients of pesticides according to their chronic hazard to human health considering carcinogenicity, mutagenicity and reproductive toxicity according to the HHP data originated from at least four different sources including three different classification systems: the Globally Harmonized System (GHS) criteria, the classification system according to Directive 67/548/EEC and the US-EPA classification on carcinogenicity. The four different sources were needed in order to gather hazard classifications for as many active ingredients as possible:

- the active ingredient has been considered to be classified as a carcinogen of category 1A or 1B according to the GHS, a mutagen or reprotoxic ("yes"),
- the active ingredient is not classified as such ("no"), or
- the active ingredient was not evaluated by these sources ("n.e.").

For this study we classified chronic hazard to human health according to the following decision rules:

- "yes" in case the active ingredient is toxic according to at least one of the sources mentioned,
- "no" in case the active ingredient is not qualified as toxic according to any of the sources and the active ingredient is qualified "not toxic" according to at least one of the sources.
- "n.e." in case the active ingredient is neither toxic nor "not toxic" according to all sources.

2.3.3 Acute environmental hazard

The parameter used to classify the acute toxicity of active ingredients of pesticides to algae is the concentration that causes a 50% reduction in growth rate or final yield (EC50) of the test organisms in a standard algae test (usually 72h). The acute toxicity of pesticides to fish and the water flea *Daphnia* (representing aquatic invertebrates) is also expressed as acute EC50 or LC50 values (an LC50 is the concentration that kills 50% of the test organisms). The classification criteria of active ingredients according to acute toxicity to aquatic organisms is listed in Table 2. The classification was established by the US-EPA: http://www.epa.gov/oppefed1/ecorisk_ders/toera_analysis_eco.htm (retrieved in July 2009).

Table 2: Categories of acute toxicity to aquatic organisms (according to EPA, 2009)

LC50 or EC50 (mg/L)	Acute hazard to aquatic organisms
< 0.1	Very highly toxic
0.1 - 1	Highly toxic
1 - 10	Moderately toxic
10 - 100	Slightly toxic
> 100	Practically nontoxic

The classification of active ingredients according to their acute toxicity to bees is based on the dose per bee that kills 50% of bees (orally or by contact). The criteria for this classification are provided in Table 3. The classification originates from the 'Manual for summarizing and evaluating the environmental aspects of plant protection products' published by the Dutch National Institute for Public Health and the Environment (Mensink et al., 1995).

Table 3: Categories of acute toxicity to bees (Mensink et al., 1995)

LD50 (µg/bee)	Hazard to bees
< 0.1	Highly toxic
0.1 - 1	Toxic
1 - 10	Moderately toxic
10 - 100	Slightly toxic
> 100	Very slightly toxic

2.3.4 Environmental Toxic Load

The Environmental Toxic Load (ETL) indicator represents the average amount of toxic pressure by active ingredients of pesticides applied on one hectare of agricultural land in one year. Toxicity is mediated by the fact that only a small proportion of the pesticide volume will reach the organism. Dissipation processes like degradation and sorption are not taken into account. A similar approach has been used by Benbrook et al. (2002) and De Blécourt et al., 2010.

The ETL indicator is calculated separately for fish, *Daphnia*, algae and bees. The ETL is based on the total imported volume of active ingredients per year, the toxicity (either L(E)C50 for algae, *Daphnia* or fish or the LD50 for bees), and the total agricultural area in Mozambique. It is calculated as:

$$ETL_{yr} = \frac{\sum_{ai} \frac{V_{ai,yr}}{T_{ai}}}{A_{yr}} \qquad \text{Eq. 3}$$

ETL_{yr} Environmental Toxic Load indicator value for one year
$V_{ai,yr}$ volume of an active ingredient imported in a particular year (kg)
T_{ai} toxicity of the active ingredient; i.e. L(E)C50 of either fish, *Daphnia* or algae (mg/L), or the LD50 of bees (µg/bee)
A_{yr} total agricultural area in Mozambique in a particular year (ha)

The ETL cannot be used to assess the actual risk (i.e., the probability of an adverse effect on organisms) as a consequence of pesticide treatments because there is no exposure assessment involved in its calculation. For instance there is no prediction of an environmental concentration (PEC) in water that can be compared with a 'no effect concentration' for water organisms (PEC/NEC analysis). There is no thresholds of the ETL that signifies an absolute risk.

The ETL can therefore only be used to evaluate the impact of changes in relative environmental hazards between pesticides and between years. Furthermore, since toxicity data for bees (LD50) are expressed on the basis of µg/bee the ETL for bees cannot be compared to the ETL values for the aquatic organisms for which the toxicity (LC50 or EC50) is expressed in mg/L. However, since the same units for toxicity are used for algae, *Daphnia* and fish, it is justified to compare ETL's between these aquatic organisms. For instance it is possible to indicate if the pesticide import in Mozambique in a given year poses a higher overall potential hazard to algae than to fish. If the ETL for algae equals 10 and the ETL for fish equals 1000 in a certain year, the overall hazard of the pesticide import in Mozambique is 100 times greater for fish than for algae.

2.3.5 Groundwater leaching potential

The Groundwater Ubiquity Score or GUS (Gustafson, 1989) is an indication of the potential of the active ingredient of a pesticide to reach the groundwater before it is degraded. The GUS is an empirically derived value that relates to the persistence and sorption to soil organic matter of the active ingredient. The GUS index is calculated as follows

$$GUS = \log(DegT50_{soil}) \cdot (4 - \log K_{OC}) \qquad \text{Eq. 4}$$

GUS	potential of an active ingredient to reach the groundwater (-)
$DegT50_{soil}$	degradation half-life in soil (d)
K_{OC}	organic carbon sorption coefficient (L/kg).

The pesticide leaching potential is derived from the GUS. The ratings of active ingredients of pesticides range from very low to very high. The criteria are set out in Table 4.

Table 4: categories of groundwater leaching potential based on the GUS index.

GUS	Class	Groundwater leaching potential
< 1.0	1	Very low
1.0 – 2.0	2	Low
2.0 – 3.0	3	Moderate
3.0 – 4.0	4	High
> 4.0	5	Very high

2.4 Pesticides of concern

After the indicators were calculated and the analyses were done, criteria were established to select pesticides of concern. These are the pesticides that represent both an high hazard to human health and/or to the environment and that are imported in relatively large quantities in Mozambique for several years. The aim of this classification is to identify those pesticides and pesticide products for which the biggest gain in terms of reducing overall hazard to human health and/or the environment can be achieved by measures such as reducing their use in the country.

We distinguish two categories: 1) pesticides of primary concern, i.e., pesticides that contribute to a very large extent to the indicator values and that really stand out, and 2) pesticides of secondary concern that also contribute significantly but in a less dominant way. Both categories of pesticides are suitable to realise reductions of overall hazards by specific measures.

The criteria are applied per indicator or per group of indicators. This means that the pesticides of concern only stand out against other pesticides for a particular hazard. The overall hazard of imported hazards may be much bigger for, say, aquatic organisms than for human health, but such comparisons cannot be made based on the type of indicators that were used.

The criteria that were applied are listed on the following page.

Acute human health hazard (WHO classification of formulated products)

Primary concern:	All active ingredients occurring in WHO Class I formulated products imported from 2002 to 2011.
Secondary concern:	Active ingredients occurring in WHO Class II formulated products of which the imported volume (of formulated products) constitutes >5% of the total annually imported volume in 2 years or more.

Chronic human health

Primary concern:	Carcinogenic, mutagenic or reprotoxic active ingredients of which the imported quantity of a.i. constitutes >5% of the total quantity of annually imported a.i. in 2 years or more.
Secondary concern:	Carcinogenic, mutagenic or reprotoxic active ingredients of which the imported quantity of a.i. constitutes >1% of the total quantity of annually imported a.i. in 1 year or more.

Environmental Toxic Loads (fish, aquatic invertebrates, algae, bees)

Primary concern:	Active ingredients of which the imported quantity of a.i. constitutes >50% of the total annual ETL value in 2 years or more.
Secondary concern:	Active ingredients of which the imported quantity of a.i. constitutes >10% of the total annual ETL value in 1 year or more.

Groundwater Ubiquity Score (GUS)

Primary concern:	GUS class 5 active ingredients of which the imported quantity of a.i. constitutes >1% of the annual GUS index value in 2 years or more. And/or GUS class 4 active ingredients of which the imported quantity of a.i. constitutes >2% of the annual GUS index value in 2 year or more.
Secondary concern:	GUS class 5 active ingredients of which the imported quantity of a.i. constitutes >0.5% of the annual GUS index value in 1 year or more. and/or GUS class 4 active ingredients of which the imported quantity of a.i. constitutes >1% of the annual GUS index value in 1 year or more.

3 Results

3.1 Agricultural statistics

The dynamics in the total agricultural area in Mozambique according to FAOSTAT data (http://faostat3.fao.org/; accessed on July 1, 2013) are shown in Figure 1. The total agricultural area increased with 1,4% during the study period (2002-2011), i.e., from 48,7 million ha in 2002 to 49,4 million ha in 2011.

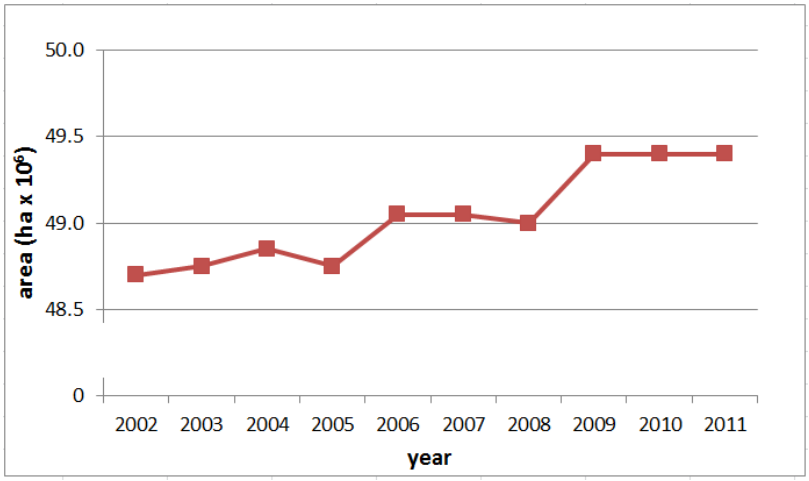

Figure 1: Total agricultural area in Mozambique in the years 2002 – 2011 (http://faostat3.fao.org/).

The total agricultural production according to FAOSTAT data (http://faostat3.fao.org/; July 1, 2013) is shown in Figure 2. These figures were calculated as the sum of eleven aggregated items[1]. The total agricultural production increased with 40% from 9,9 million tonnes in 2002 to 13,9 million tonnes in 2011. Because the cultivated area in the country did hardly increase over this period, it can be concluded that agriculture in Mozambique must have considerably intensified during this period.

[1] Cereals, Total; Citrus Fruit, Total; Coarse Grain, Total; Fibre Crops Primary; Fruit excl Melons, Total; Jute & Jute-like Fibres; Oilcrops Primary; Pulses, Total; Roots and Tubers, Total; Treenuts, Total; and Vegetables Primary.

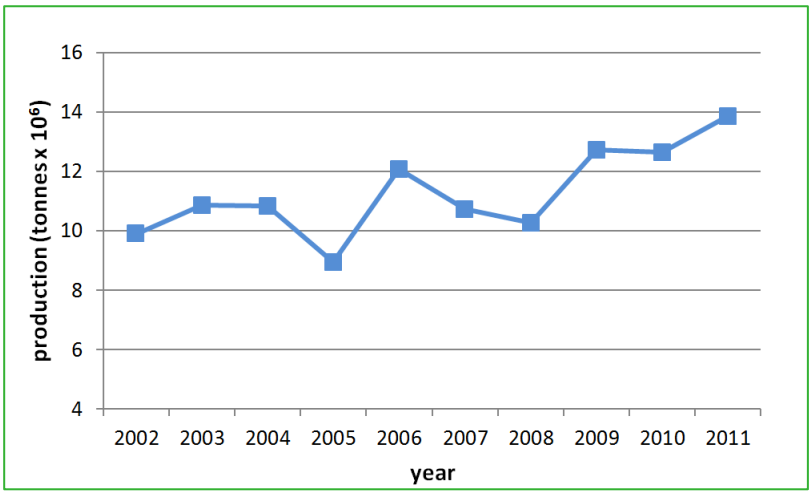

Figure 2: The total agricultural production in Mozambique in the years 2002 – 2011 (http://faostat3.fao.org/).

3.2 Pesticide imports

This section provides insights into trends in pesticide imports into Mozambique from 2002 to 2011. Trends are shown in the annual numbers and types (Section 3.2.1), the volume (Section 3.2.2) and the monetary value of imported pesticides (Section 3.2.3). In addition, the volume and the monetary value of imported pesticides are presented per unit of agricultural land and per unit weight of harvested product.

The Import data contain a relatively small number of import events for the first year, 2002. It seems logical that the dataset for this year is incomplete, but the authors have not received a confirmation of this. Since we cannot be entirely sure that the data of 2002 are representative for the entire year, we have decided to include the year 2002 in the graphs and tables but not to discuss the results for this particular year each time indicator values are lower compared to the other years.

3.2.1 Imported numbers of pesticides

Products

The annual number of formulated pesticide products imported is shown in Figure 3. The number fluctuates slightly and increases from 115 in the year 2003 to 157 in the year 2011.

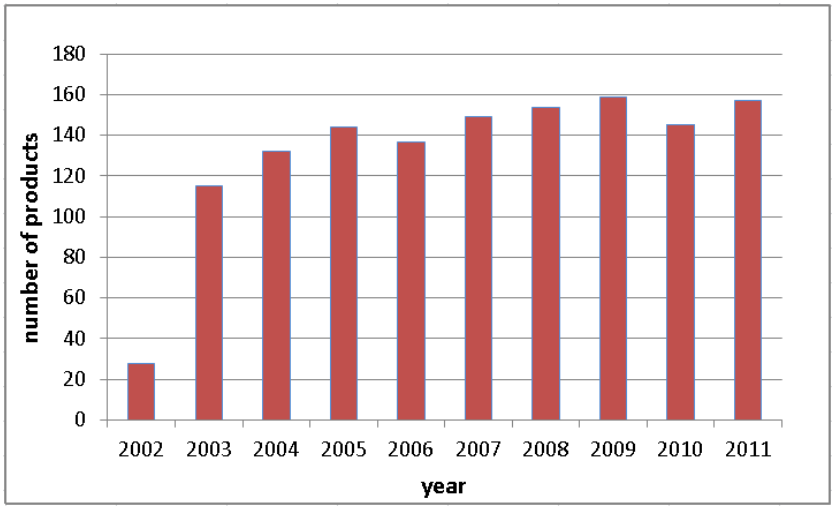

Figure 3: The annual number of formulated pesticide products imported in the years 2002 – 2011.

Product groups

The distribution of formulated pesticide products among the eight functional pesticide groups is shown in Figure 4. Insecticides constitute the major product group in all years, followed by herbicides and fungicides.

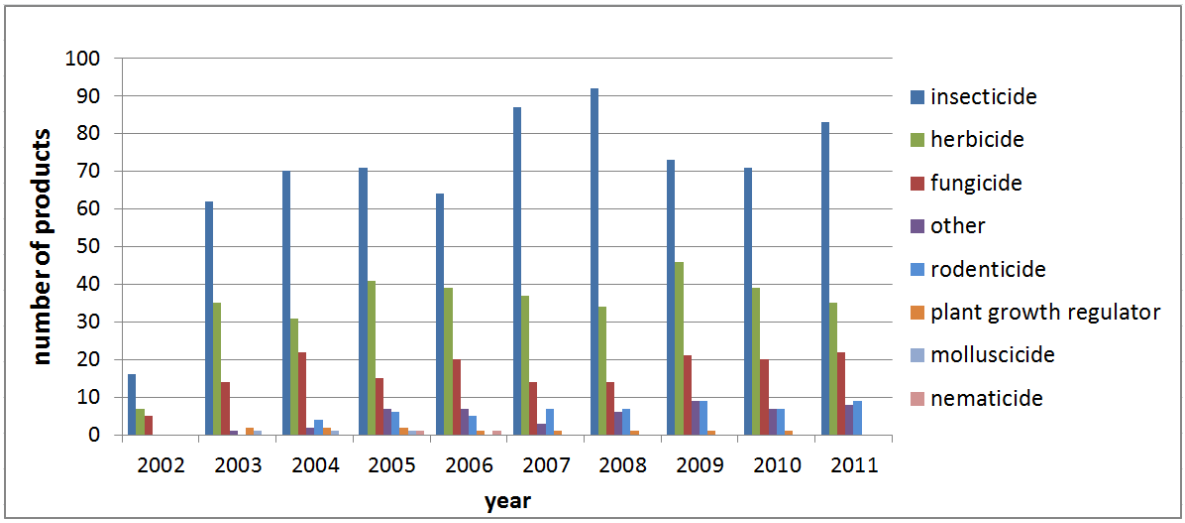

Figure 4: The number of formulated pesticide products per functional pesticide group imported yearly from 2002 to 2011.

Active ingredients

The formulated pesticide products imported in the period 2002-2011 contain 175 active ingredients assigned to 72 different chemical classes. The chemical classes with the largest number of active ingredients are the organophosphates (19 active ingredients), pyrethroids (16), carbamates (9), inorganic compounds (9), biopesticides (8), unclassified compounds (8), triazines (8) and triazoles (6). The annual number of chemical classes of active ingredients in the imported pesticides is shown in Figure 5. The numbers of the types of pesticides imported in the country increased up to 2005 and the fluctuated between c. 45 and 55.

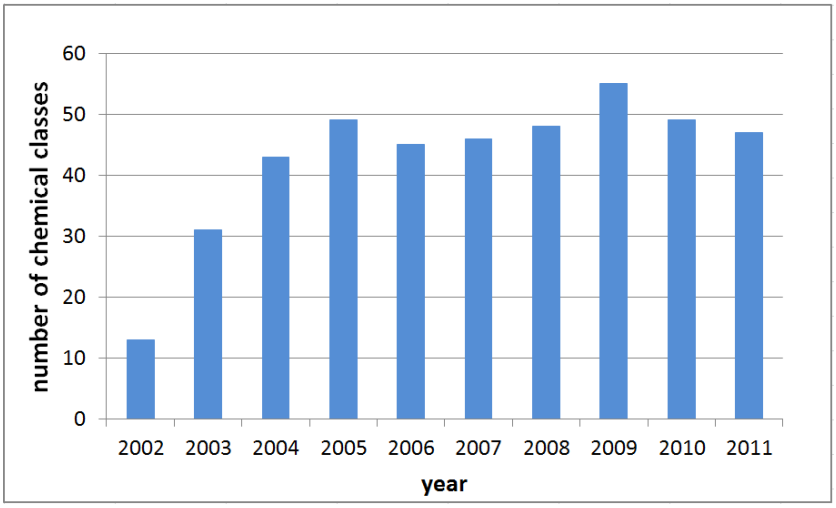

Figure 5: The number of chemical classes of the active ingredients imported annually in the years 2002 – 2011.

Importers

The annual number of active pesticide importers in Mozambique is shown in Figure 6. The numbers increase from 2002 to 2004, but decline in 2005 and 2006. From 2007 onwards the number increases again and the maximum number of importers is reached in the year 2010. Forty-four different importers were identified based on the Import data. The number of imported pesticide products per major importer is shown in Figure 7.

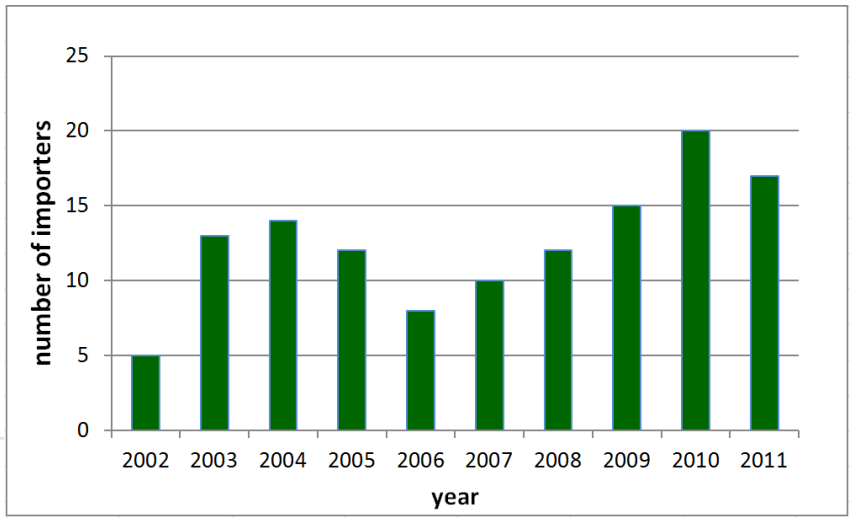

Figure 6: The number of pesticide importers responsible for the yearly imports from 2002 to 2011.

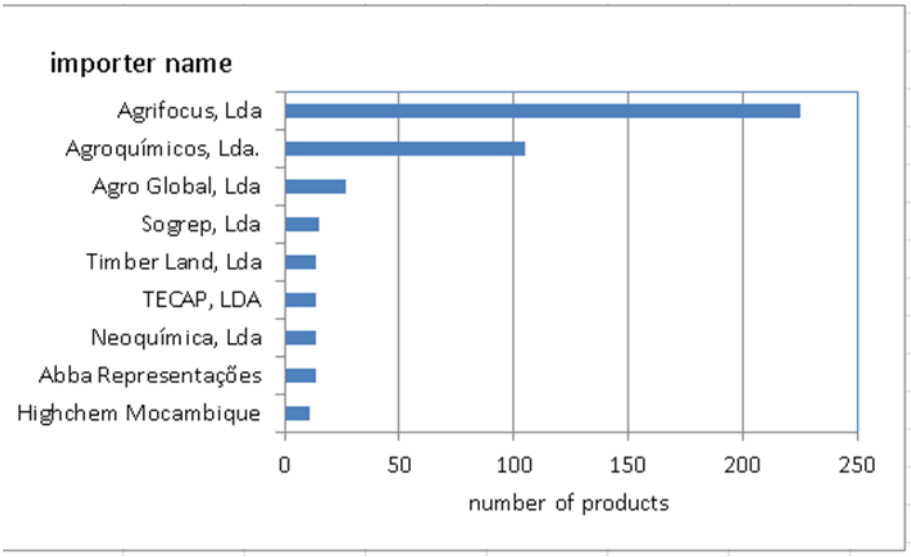

Figure 7: The total number of products imported by the major importers in the period 2002-2011.

3.2.2 Imported pesticide volume

Products

The annual volume of imported pesticides is shown in Figure 8. The imported volume increases until the year 2006. In the next year, 2007, the volume decreases by 37% to 1278 tonnes. As from 2008, the volume increases again to 2592 tonnes in the year 2011.

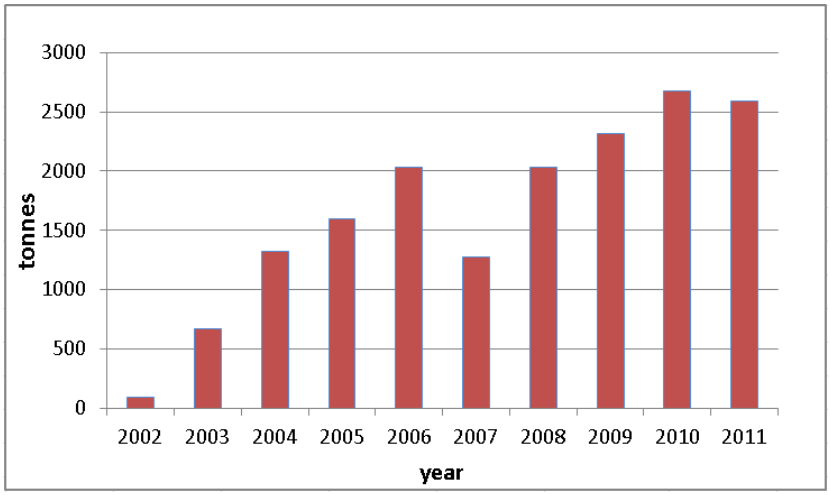

Figure 8: The annual volume of imported pesticide products in the years 2002 – 2011 (tonnes).

The volume of imported pesticides corrected for the total agricultural area (Figure 1) is shown in Figure 9, expressed in kg pesticides per hectare agricultural land. Because the total cultivated area changed only little during the study period, the pattern in Figure 9 is the same as in Figure 8.

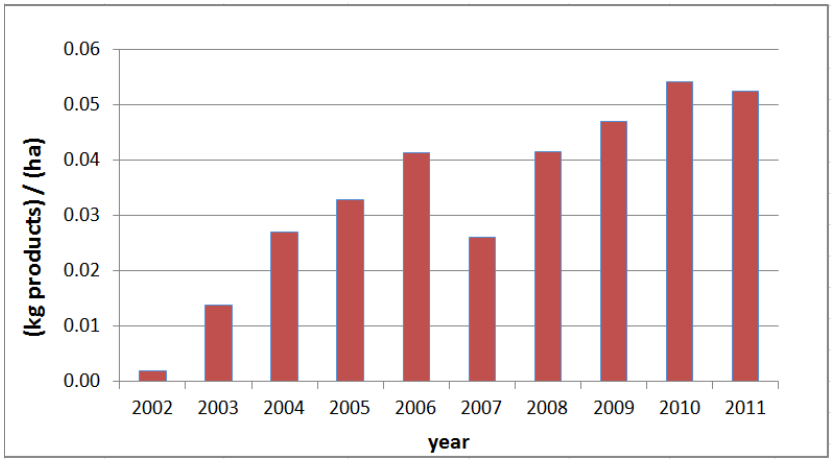

Figure 9: The annual volume of imported products corrected for the total agricultural area in the years 2002 – 2011 (kg/ha).

The volume of imported pesticides corrected for the total agricultural production (Figure 2) is shown in Figure 10. In the year 2007, the corrected volume of imported products decreases with 29% to 0.12 kg per ton harvested products. The figure clearly shows that although the total pesticide import per hectare in Mozambique is increasing (Figure 9), the pesticide import per tonne of harvested produce has been more or less constant from 2008 to 2011.

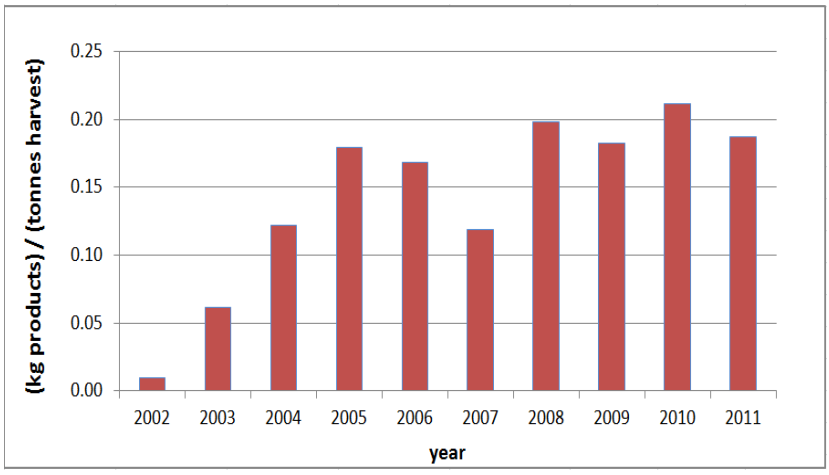

Figure 10: The annual volume of imported products corrected for the total agricultural production in the years 2002 – 2011 (kg products imported per ton of harvested products).

Product groups

The annual volume of imported products belonging to the eight functional groups is shown in Figure 11. Insecticides and herbicides constitute the major groups, followed by fungicides. The total amount of imported formulated pesticides increases in the first half of the decade and shows a dip in 2007. From 2008 to 2011 it is approximately the same. The annual volumes of insecticides and herbicides are more or less equal except in the years 2006 and 2008. In these two years, the volume of insecticides exceeds the volume of herbicides by some 50%.

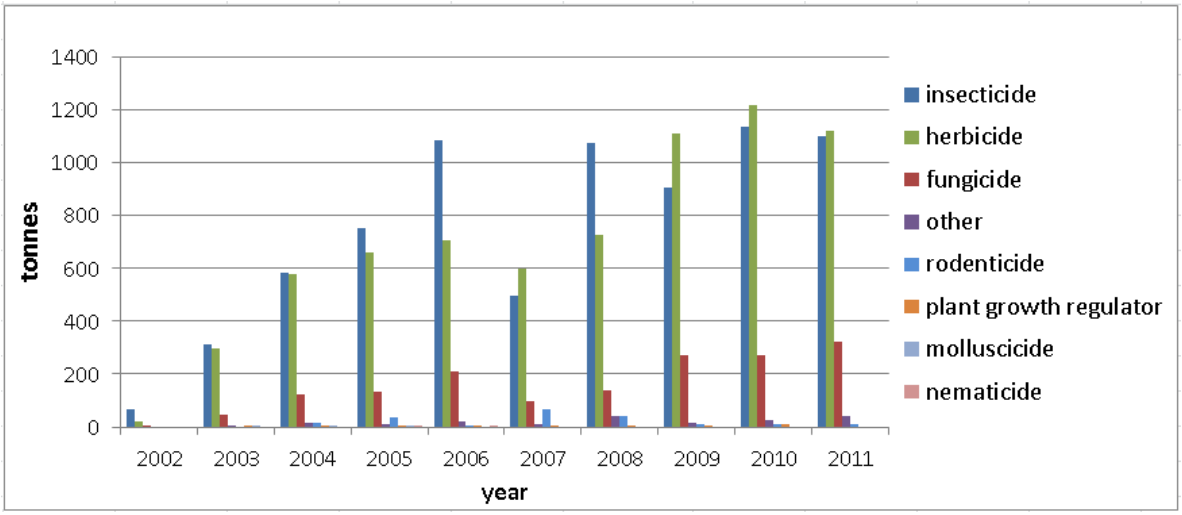

Figure 11: The annual volume per imported product group in the years 2002 – 2011 (tonnes)

The volume of imported pesticides belonging to the eight functional groups corrected for the total agricultural area (Figure 1) is shown in Figure 12. This parameter shows the same pattern as the uncorrected import data in Figure 11.

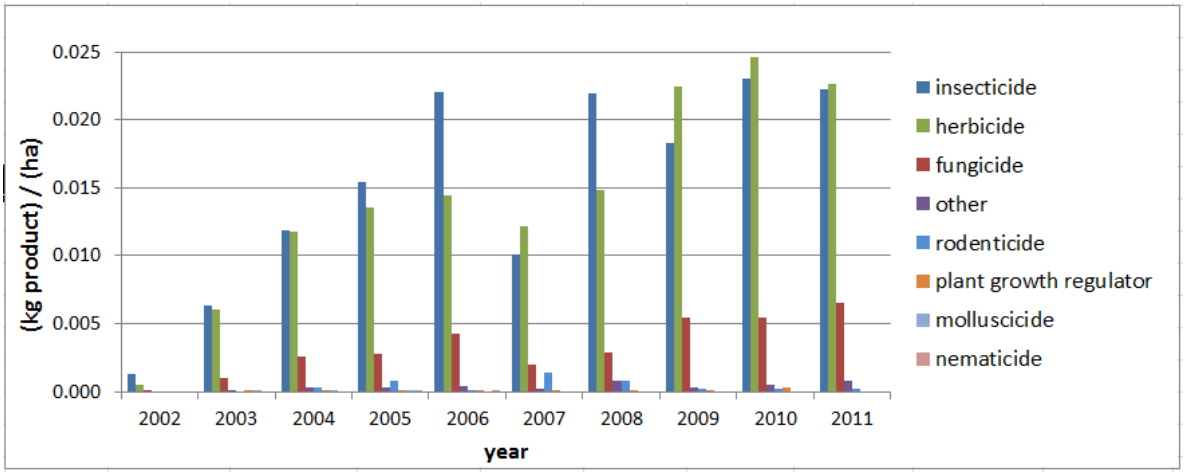

Figure 12: The annual volume per imported product group corrected for the total agricultural area in the years 2002 – 2011 (kg product/ ha)

The volume of imported pesticides corrected for the total agricultural production (Figure 2) is shown in Figure 13. The imports corrected for production still show the same pattern. A slight difference is that insecticide imports peak in 2008 instead of 2010.

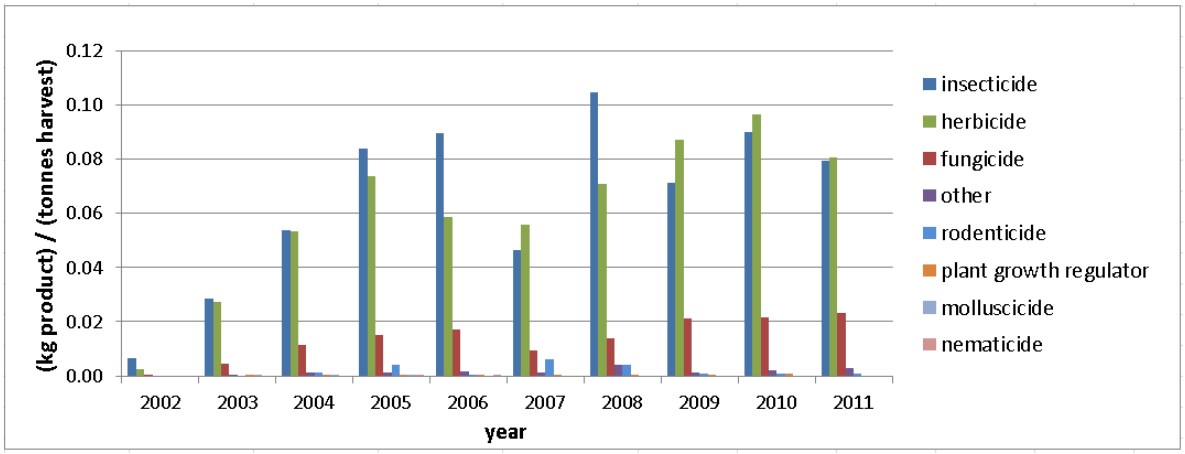

Figure 13: The annual volume per imported product group corrected for the total agricultural production in the years 2002 – 2011 (kg product / tonnes harvest)

Active ingredients

The annual volume of active ingredients per chemical class are shown in Figure 14. These are the major chemical classes based on the total volumes of products imported in the entire period 2002-2011. The volume of active ingredients in the chemical class of organochlorine compounds almost entirely consists of DDT (89% in the year 2005, 97% in 2006, and 100% in 2008). According to the Import data, DDT was only imported in these three years. There are conspicuous peaks in its import in 2006 and 2008, i.e., more DDT was imported that any other class of active ingredients. Endosulfan is the only other active organochlorine ingredient imported in the 10-year period. Another group of active ingredients that are reportedly imported in relative large quantities are the arsenates. Imports of these compounds keep on increasing from 2002 to 2011.

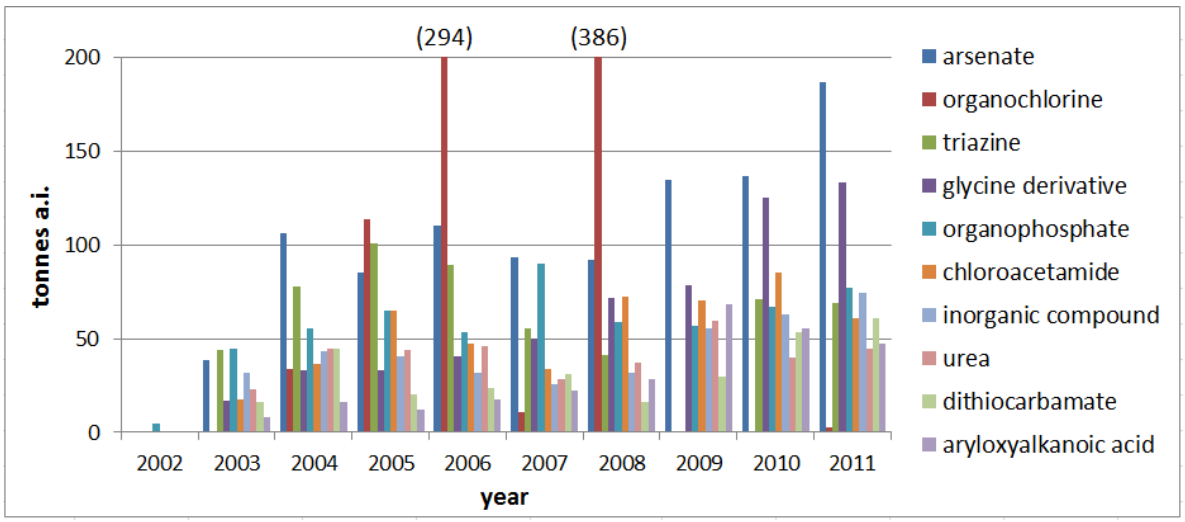

Figure 14: The annual volume per chemical class of active ingredients imported in the years 2002 – 2011 (in tonnes a.i.)

Importers

The five major importers in terms of their contribution to the total volume of imported products in the period 2002-2011 are shown in Figure 15. Agrifocus Lda is the major importer with almost 70% of the total volume of imported products in the entire period 2002-2011. The contributions of importers Agrifocus Lda and Sogrep Lda cover the entire period, whereas Abba Representações covers the years 2003-2011, Agroquímicos Lda covers the years 2002-2010, and Medimoc SA covers the years 2002-

2009. Contrary to these major importers, the majority of the other importers only contribute to the imported volume in one or two years over the 10-year period.

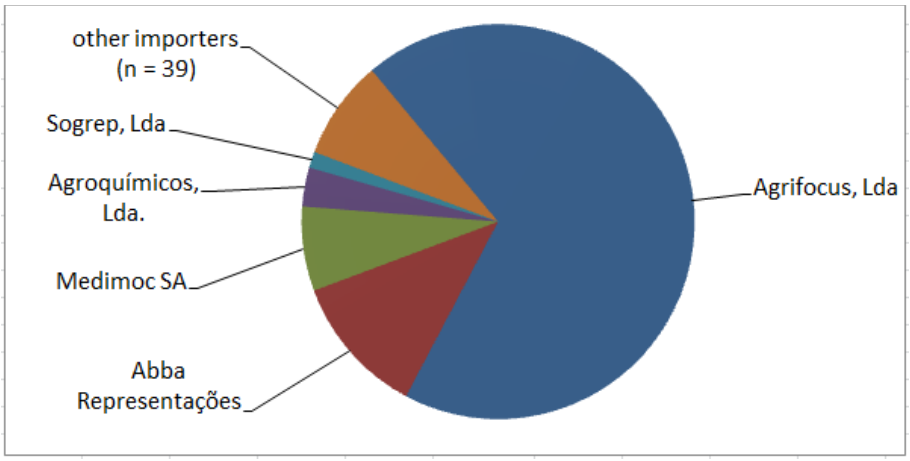

Figure 15: The five major pesticide importers according to the total volume of imported products in the period 2002-2011.

3.2.3 Monetary value

The monetary value of the imported quantity in the Import data is expressed in Metical or New Metical. In order to prepare the graphs and figures in this section, the monetary values in Metical (the years 2002 – 2005 and part of 2006) were converted into New Metical (1 Metical = 0.001 New Metical). The number of import events, the average price per L (or per kg) and the total monetary value of the imported product are shown in Table 5.

Table 5: The annual number of import events with the average price (in New Metical per L or per kg imported product)

Year	Number of import events	Average price per L or per kg in New Metical	Day rate US Dollar	Average price per L or per kg in US dollars	Total value of imports in New Metical (million)	Total value of imports in US dollar
2002	41	22	24.19	0.91	6.3	0.26
2003	263	100	24.02	4.17	115.2	4.80
2004	430	104	21.67	4.80	208.9	9.64
2005	493	112	26.68	4.20	309.5	11.60
2006	494	81	25.23	3.21	289.2	11.47
2007	431	123	25.79	4.77	202.7	7.30
2008	487	108	24.54	4.40	304.0	12.39
2009	563	191	27.40	6.96	459.6	16.78
2010	578	152	34.52	4.41	601.3	17.42
2011	590*	159	27.19	5.85	422.6	15.55

*For this year some import events were merged. Calculations were based on 461 import records.

Products

The annual monetary value of imported pesticides is shown in Figure 16 (in millions New Metical). The value of the imported pesticide products increases over the years with a dip in 2007 and a maximum in 2010. The annual value of imported pesticides corrected for the total agricultural area (Figure 1) is shown in Figure 17 (expressed in New Metical per hectare agricultural land) and the annual value of

imported pesticides corrected for the total agricultural production (Figure 2) is shown in Figure 18. The patterns for these corrected import data are comparable to the uncorrected imports.

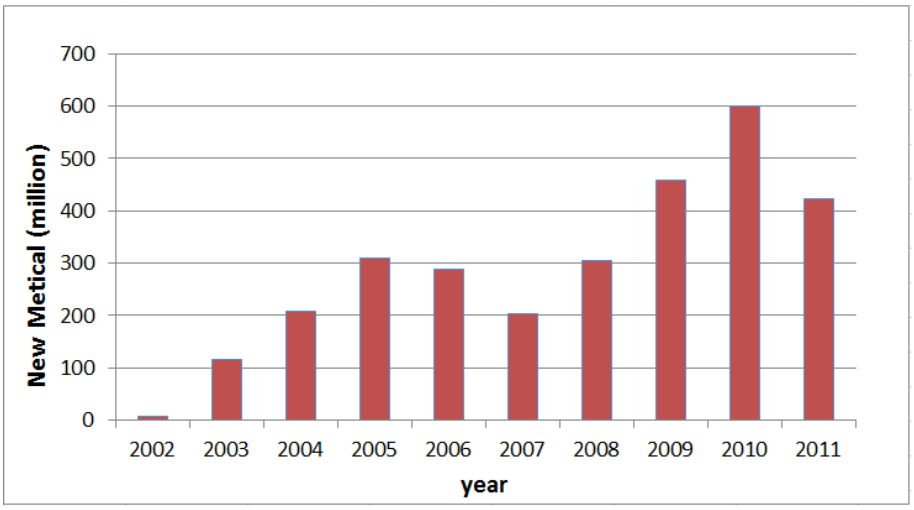

Figure 16: The annual value of imported products in the years 2002 – 2011 (million New Metical)

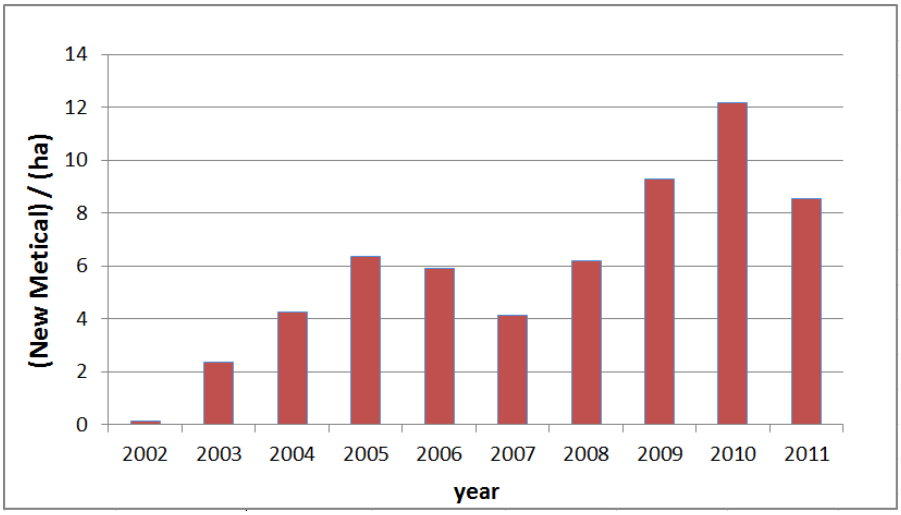

Figure 17: The annual value of imported products corrected for the total agricultural area in the years 2002 – 2011 (New Metical/ha)

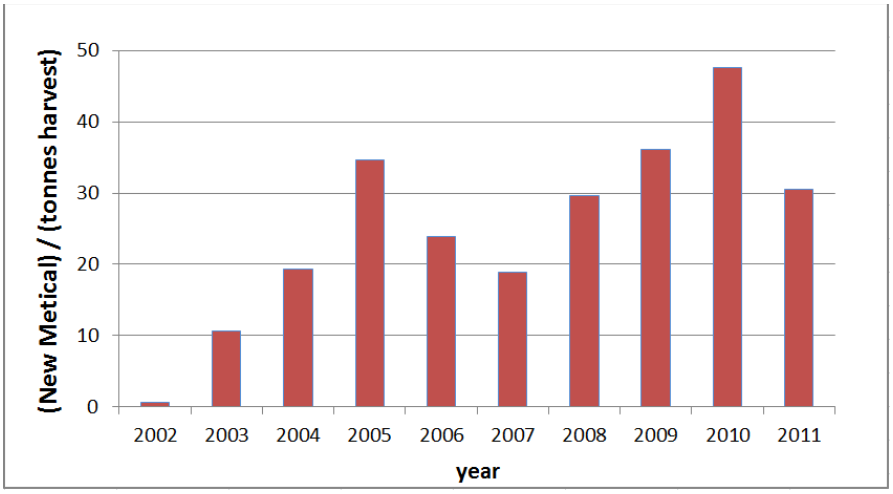

Figure 18: The annual value of imported products corrected for the total agricultural production in the years 2002 – 2011 (New Metical per ton harvested products)

Product groups

The annual value of imported products belonging to the major functional groups is shown in Figure 19. Imported insecticide products represent the highest imported value, followed by herbicides and fungicides. Since the imported volumes of insecticides and herbicides are comparable, imported insecticides must be more expensive than herbicides on average.

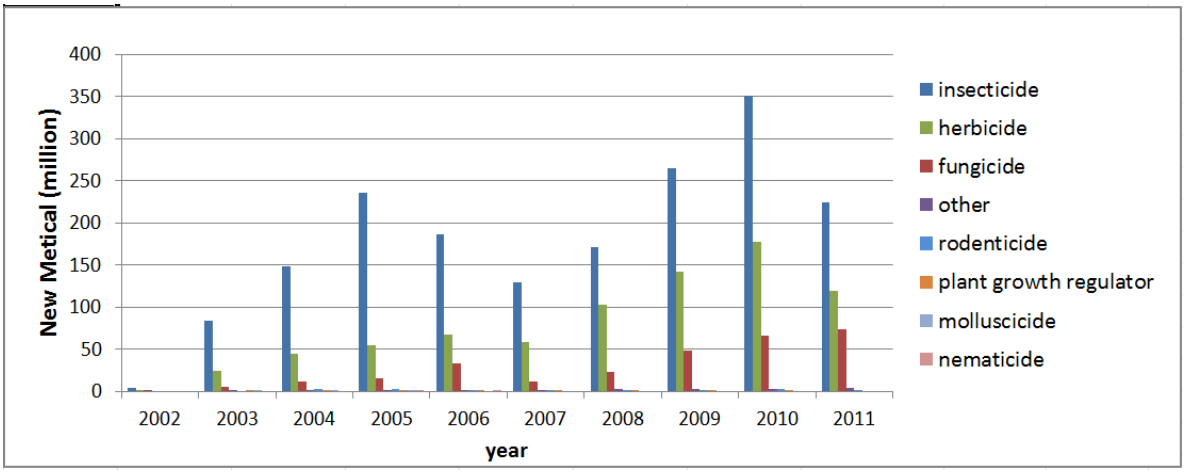

Figure 19: The annual monetary value per imported product group in the years 2002 – 2011 (million New Metical)

Importers

The five major importers according to the contribution to the total value of imported products in the period 2002-2011 are shown in Figure 20. These are also the importers with the major contribution in terms of volume (Figure 15).

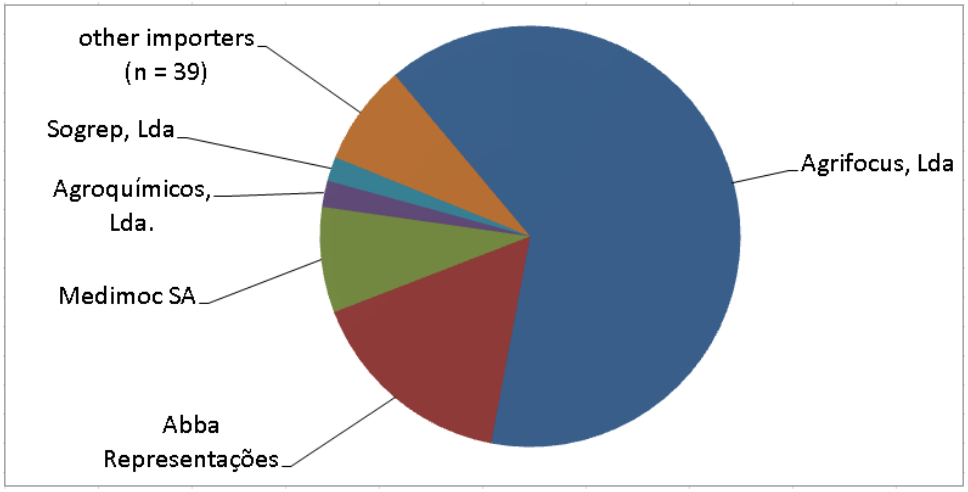

Figure 20: The five major pesticide importers according to the total value of imported products in the period 2002-2011 (in New Metical).

3.3 Acute hazard to human health

The classification of acute hazard to human health is made on a product basis according to Equations 1, 2 and the class boundaries shown in Table 1. The annual number of pesticide products per WHO

Class of acute hazard to human health is shown in Figure 21. Over the study period no products of the highest hazard class were imported (Ia, Extremely hazardous). The number of imported Highly hazardous pesticide products remains constant over the years at approximately 10 pesticides per year. The number and fraction of imported pesticide products unlikely to represent an acute hazard steadily increases over the ten years.

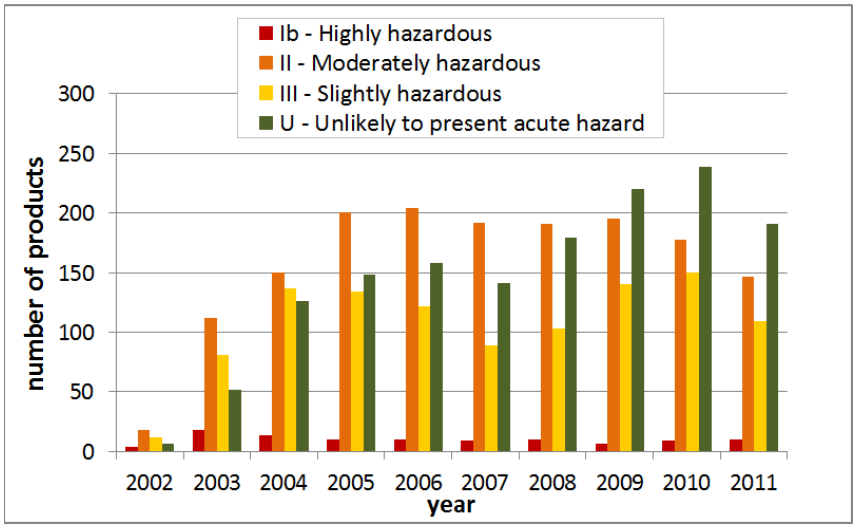

Figure 21: The annual imported number of pesticide products per WHO Class of acute hazard to human health in the period 2002-2011.

The annual volume of pesticide products per WHO Class of acute hazard to human health is shown in Figure 22. This graphs more clearly shows that fraction of imported volumes of moderately hazardous pesticides (Class II) of the total imported volume decreases whereas the fraction unlikely to present a hazard increases.

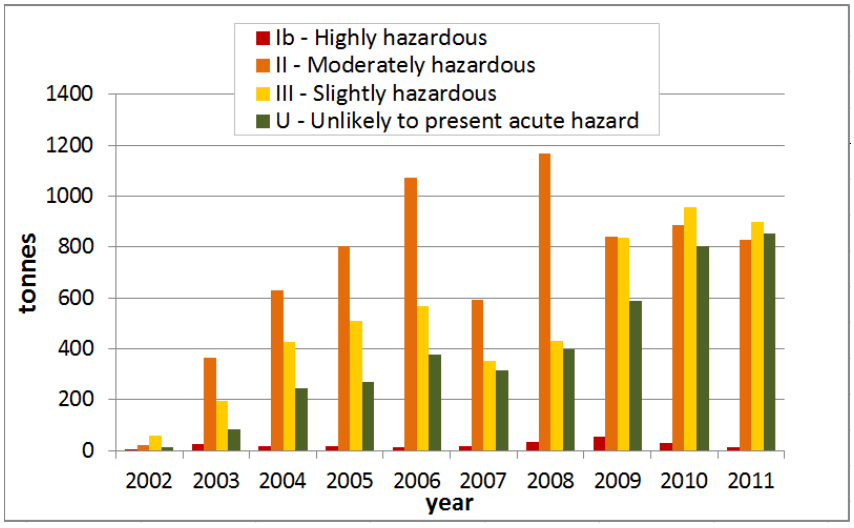

Figure 22: The annual volume of imported products per WHO Class of acute hazard to human health in the period 2002-2011 (tonnes).

In Table 2.1 in Annex 2 the imported pesticide products in WHO class Ib and II for each year are provided. The imported products in these classes change from year to year, but it can be seen that many of the Class Ib products contain only a few active ingredients under varying product names (also see Annex 5): abamectin (trade names: Agrometic, Moz Abamec Plus, Volcano), aldicarb (Temik, Volcano), aluminium phosphide (Moz Aluminium phoshide, Phosgard, Fumaphos, Falfume, Quickphos,

Volcano), fenamiphos (Nemacur, Volamiphos), Methomyl (Kuik), mevinphos (Universal), monocrotophos (Universal, Phoskill), oxamyl (Villa Platoon, Vydate) and terbufos (Rotam, Bongo). These pesticides of primary concern do only represent a small percentage of the yearly imports in Mozambique (<2% per product per year). Furthermore, the Class II products (moderately hazardous) representing >5% of total annual imports in two years or more (secondary concern) contained ametryn, DDT and lambda-cyhalothrin.

3.4 Chronic hazard to human health

The annual numbers and the volumes of imported pesticide per class of chronic hazard to human health are presented on active ingredient basis. The classification of chronic hazard to human health is taken from the Registered pesticide data (Section 2.3.2).

3.4.1 Carcinogenicity

The annual number of active ingredients per class of carcinogenicity is shown in Figure 23. The number of active ingredients in GHS Category 1A or 1B is less than ten per year and the majority of imported active ingredients are non-carcinogenic.

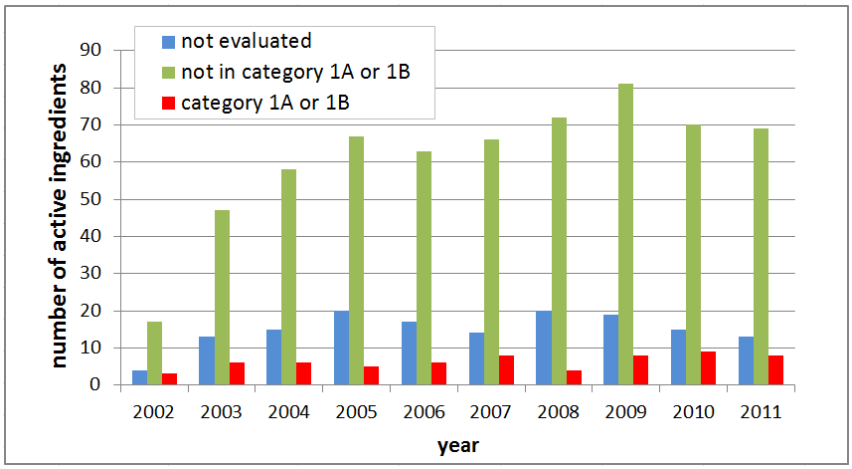

Figure 23: The annual number of imported active ingredients per class of carcinogenic hazard in the period 2002-2011.

The annual volume of active ingredients per class of carcinogenic hazard is shown in Figure 24. This graphs presents a slightly different picture than Figure 23. A relatively large volume of imported active ingredients is not evaluated in terms of carcinogenicity, especially those imported in 2006 and 2008. The imported amount of a.i. in GHS Category 1A or 1B is around 100 tonnes a year.

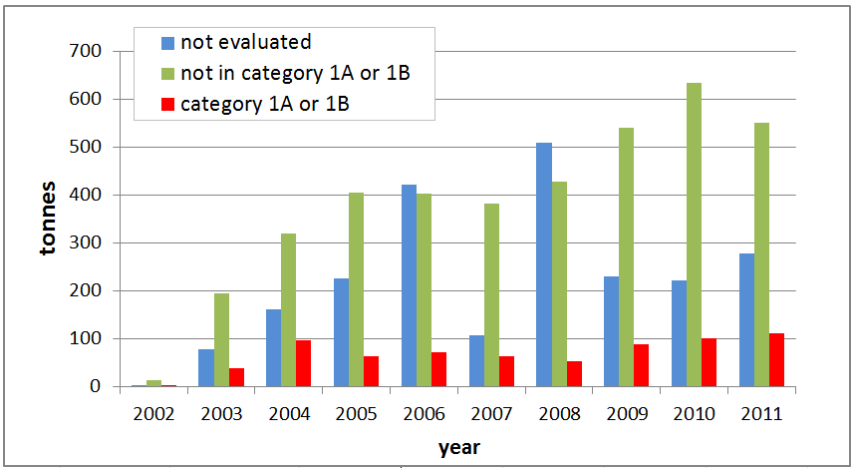

Figure 24: The annual volume of imported active ingredients per class of carcinogenic hazard in the period 2002-2011 (tonnes).

In Table 2.2 in Annex 2 the carcinogenic active ingredients that were imported in Mozambique are summarised. Carcinogenic active ingredients of primary concern (>5% in two years or more) are diuron (trade names: Diuron, Acticide, Rocima, Volcano) and mancozeb (>10 formulated products and trade names, see Annex 5 for the complete list). One carcinogenic active ingredient constituted >1% of the imports in one year, dichlorvos. This a.i. is of secondary concern.

3.4.2 Mutagenicity

The annual number of active ingredients per class of mutagenic hazard is shown in Figure 25. Only very few mutagenic active ingredients are imported in Mozambique. The majority of imported a.i. is non-mutagenic and for some substances there is no information.

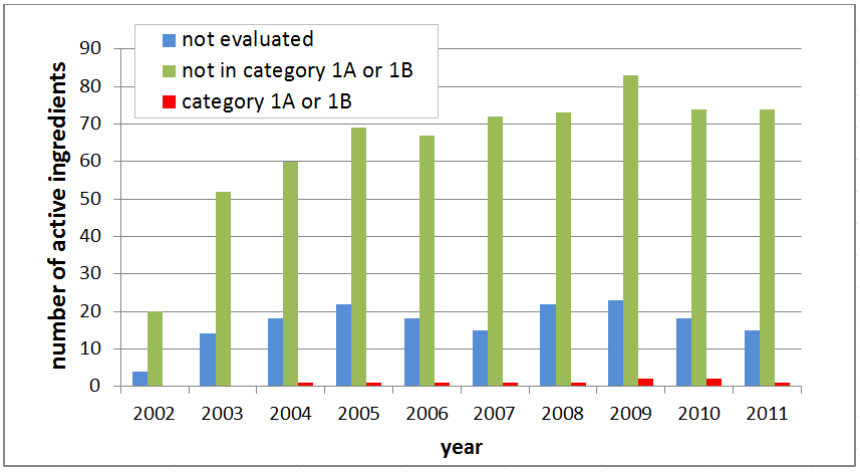

Figure 25: The annual number of imported active ingredients per class of mutagenic hazard in the period 2002-2011.

The annual imported volume of active ingredients per class of mutagenic hazard is shown in Figure 26. In terms of imported quantities, mutagenic active ingredients are almost negligible. As for the carcinogens, in 2006 and 2008 relative large volumes of active ingredients imported for which there is no information on their mutagenicity.

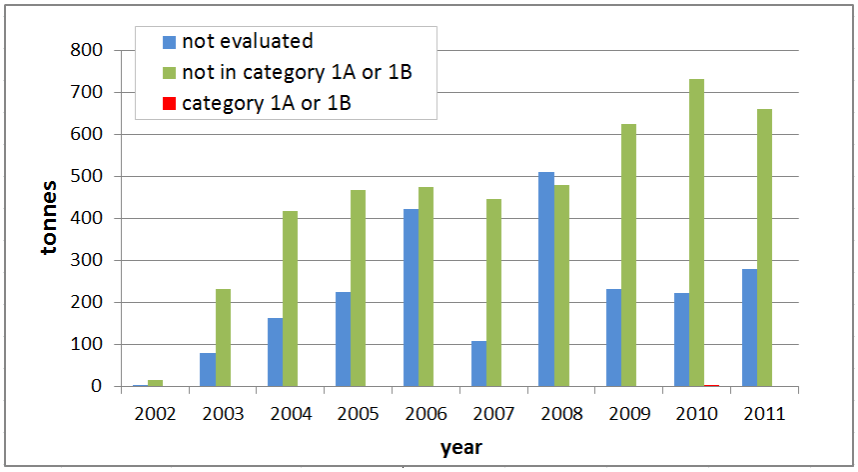

Figure 26: The annual volume of imported active ingredients per class of mutagenic hazard in the period 2002-2011 (tonnes).

In Table 2.3 in Annex 2 the mutagenic active ingredients that were imported in Mozambique are summarised. Only two active ingredients occur in this table, benomyl and carbendazim. They are not imported in Mozambique in large quantities (0.3% of total yearly imported volume or less) and are not compounds of primary or secondary concern according to the criteria used.

3.4.3 Toxicity to reproduction

The annual number of active ingredients per hazard class of reproductive toxicity is shown in Figure 27. Only very few a.i. that are toxic to reproduction are imported.

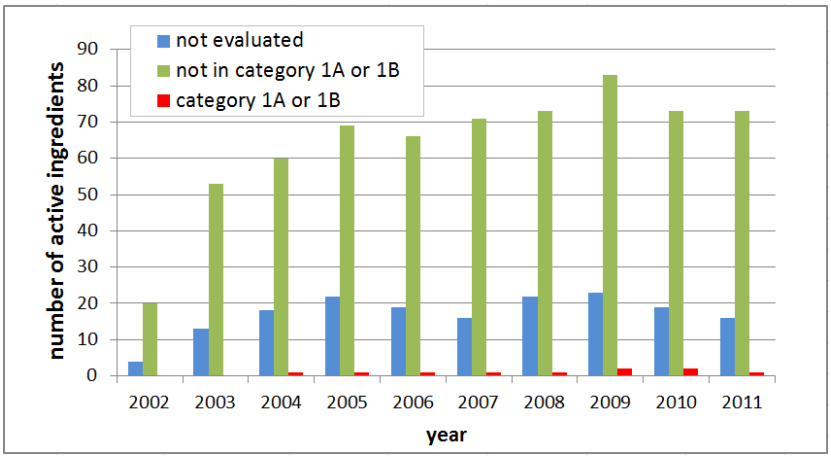

Figure 27: The annual number of imported active ingredients per hazard class of reproductive toxicity in the period 2002-2011.

The annual volume of active ingredients per hazard class of reproductive toxicity is shown in Figure 28. Again, almost no reproductively toxic a.i. are imported in Mozambique, but in 2006 and 2008 relative large volumes of active ingredients imported for which there is no information on reproductive toxicity.

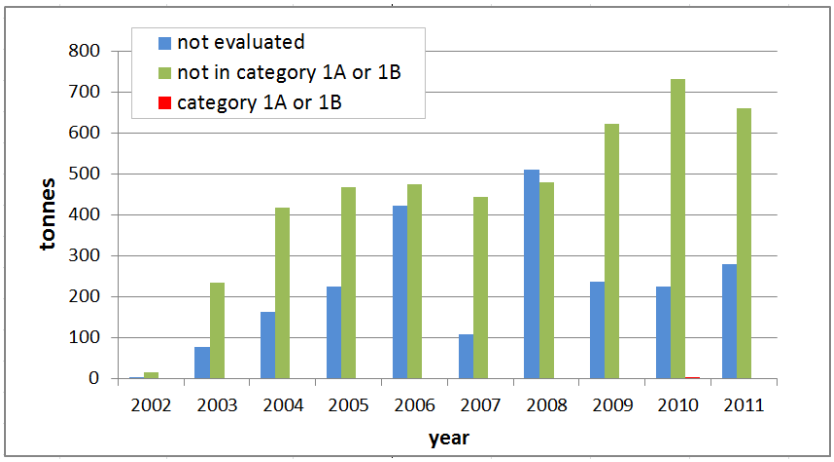

Figure 28: The annual volume of imported active ingredients per hazard class of reproductive toxicity in the period 2002-2011 (tonnes).

Table 2.4 in Annex 2 summarises the active ingredients that were imported in Mozambique and that are toxic to reproduction. The compounds in this table are the same as the mutagenic compounds (Table 2.3 in Annex 2): benomyl and carbendazim. These are not of primary or secondary concern (see §3.4.2).

3.5 Acute environmental hazard

The numbers and volumes per environmental hazard class are presented on active ingredient basis.

3.5.1 Fish

The annual number of imported active ingredients per fish toxicity class is shown in Figure 29. The graph shows that the active ingredients imported in Mozambique are relatively toxic to fish. More than half of the a.i. is moderately to highly toxic to fish and the relative numbers change little from 2002 to 2011.

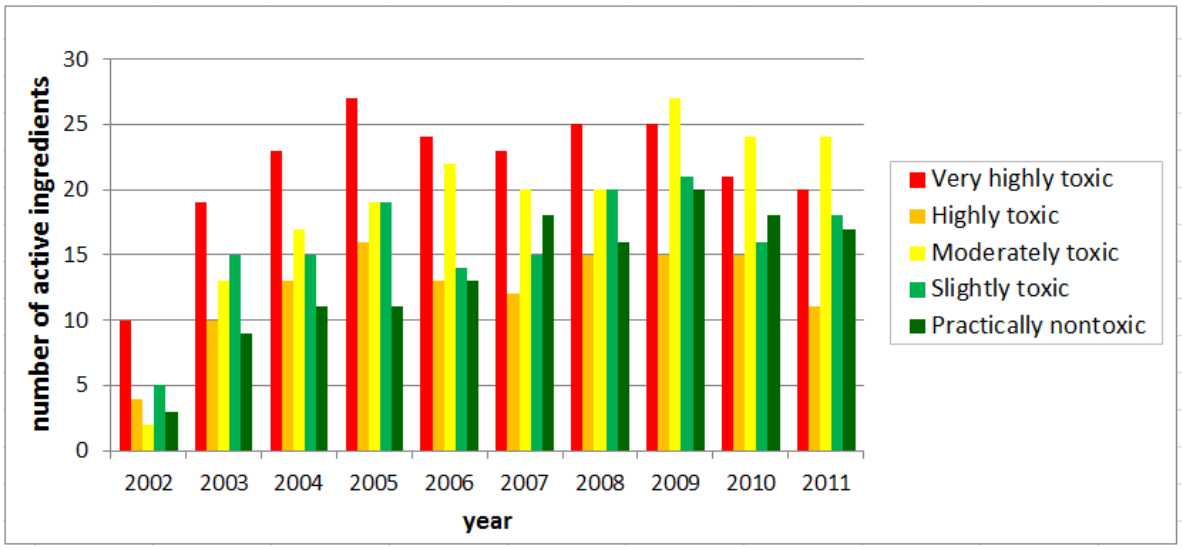

Figure 29: The annual number of imported active ingredients per fish toxicity class in the period 2002-2011.

The annual volume of active ingredients per fish toxicity class is shown in Figure 30. This image is different from Figure 29. Here, it can clearly be seen that imported volume of active ingredients that is only slightly or practically non-toxic to fish increases over the years. In 2011 more than half of the imported volume of a.i. belongs to these two classes. In 2005, 2006 and 2008 peaks can be observed for the imported volumes of a.i. that are moderately toxic to fish. These are caused by the relatively high amounts of DDT imported in Mozambique in those years.

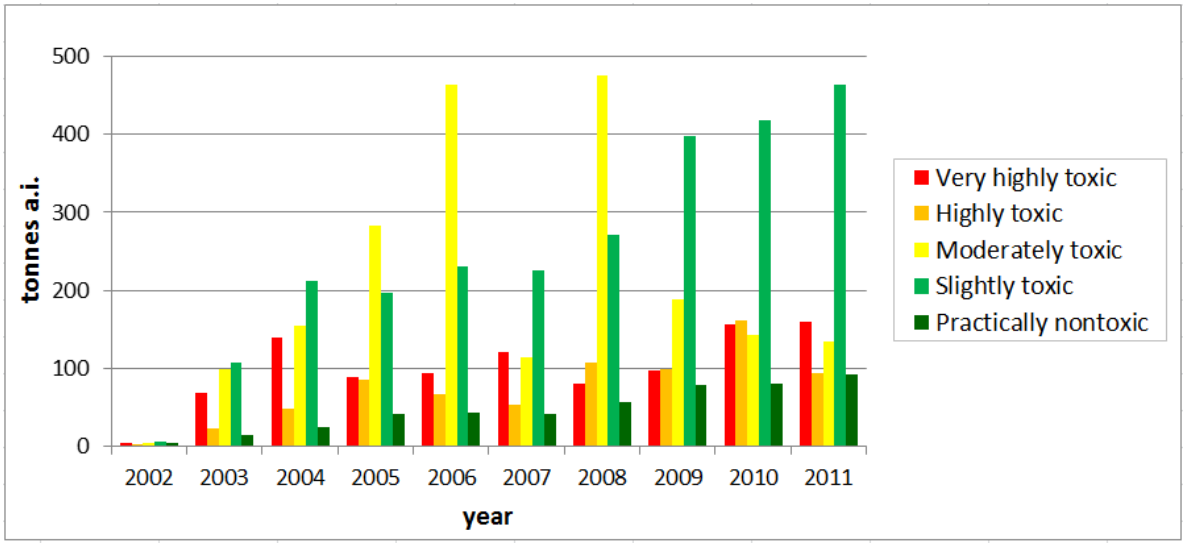

Figure 30: The annual volume of imported active ingredients per fish toxicity class in the period 2002-2011 (tonnes).

3.5.2 Aquatic invertebrates

The annual number of active ingredients per *Daphnia* toxicity class is shown in Figure 31. Many imported active ingredients are toxic to *Daphnia* and thus to aquatic invertebrates. The relative numbers of imported that are toxic change little over time.

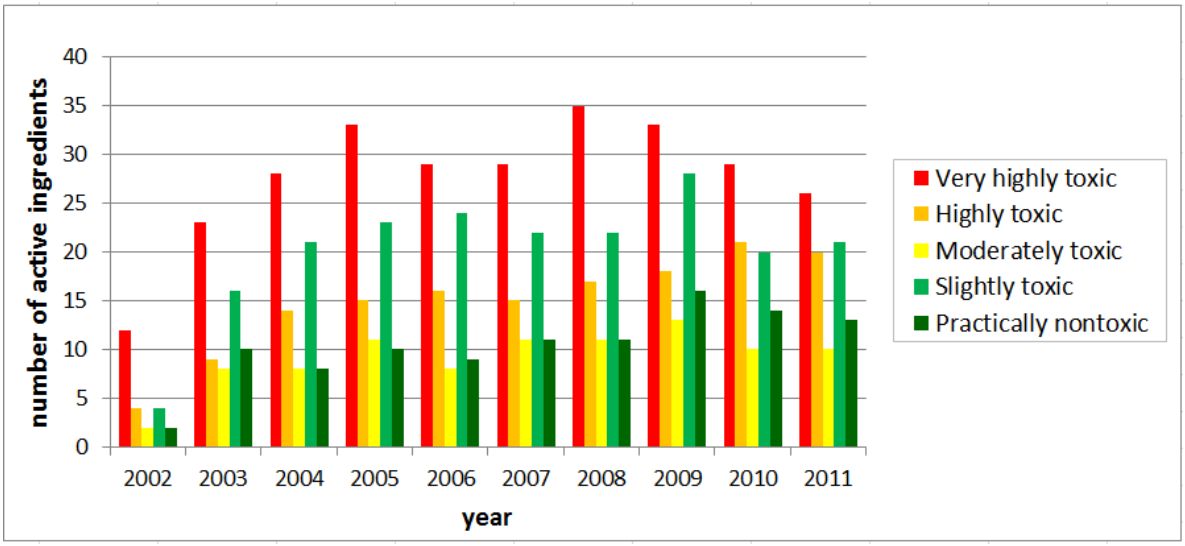

Figure 31: The annual number of imported active ingredients per *Daphnia* toxicity class in the period 2002-2011.

The annual volume of active ingredients per *Daphnia* toxicity class is shown in Figure 32. Expressed as imported volumes of a.i., the fractions highly and very highly toxic a.i. are lower, with the exception of the two familiar peaks in 2005, 2006 and 2008 (DDT). Over the years the relative imported volume of compounds that are slightly or practically non-toxic increases.

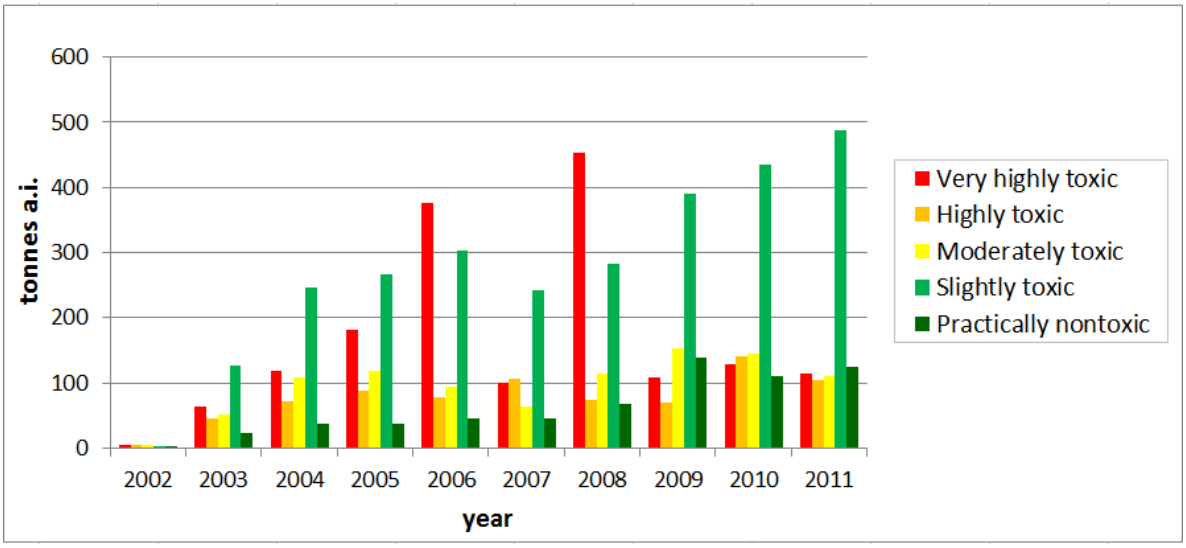

Figure 32: The annual volume of imported active ingredients per *Daphnia* toxicity class in the period 2002-2011 (tonnes).

3.5.3 Algae

The annual imported number of active ingredients per algae toxicity class is shown in Figure 33. More than half of the active ingredients imported in Mozambique are moderately, highly or very highly toxic to algae and relative numbers change little over time.

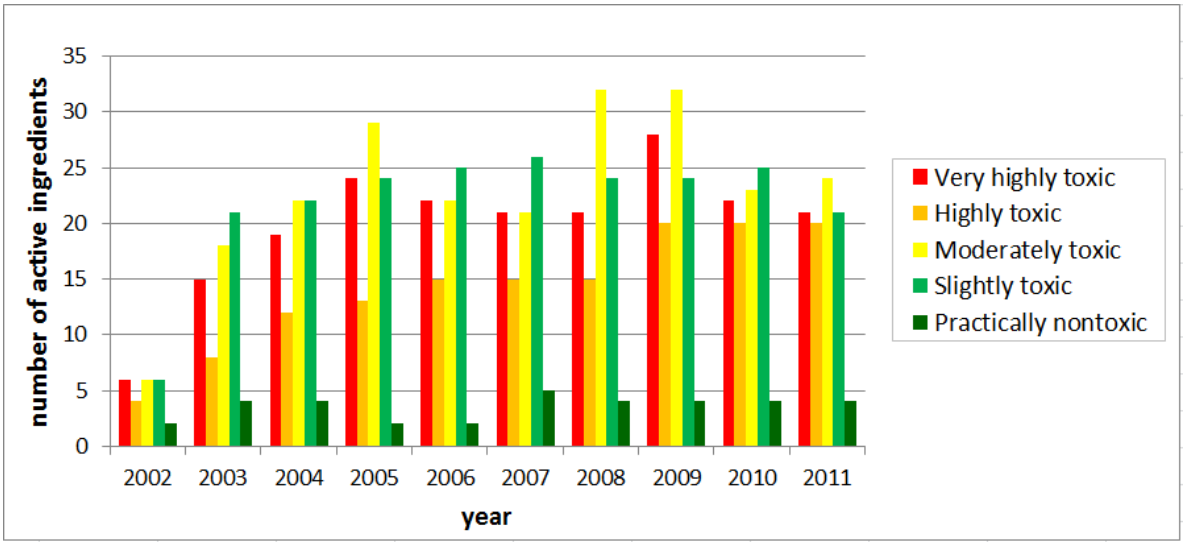

Figure 33: The annual number of imported active ingredients per algae toxicity class in the period 2002-2011.

The annual volume of active ingredients per algae toxicity class is shown in Figure 34. From 2004 to 2011 the imported volumes a.i. per class change little. The exceptions are the peaks for slightly toxic a.i. in 2005, 2008 and 2009, caused by the relatively high imports of DDT.

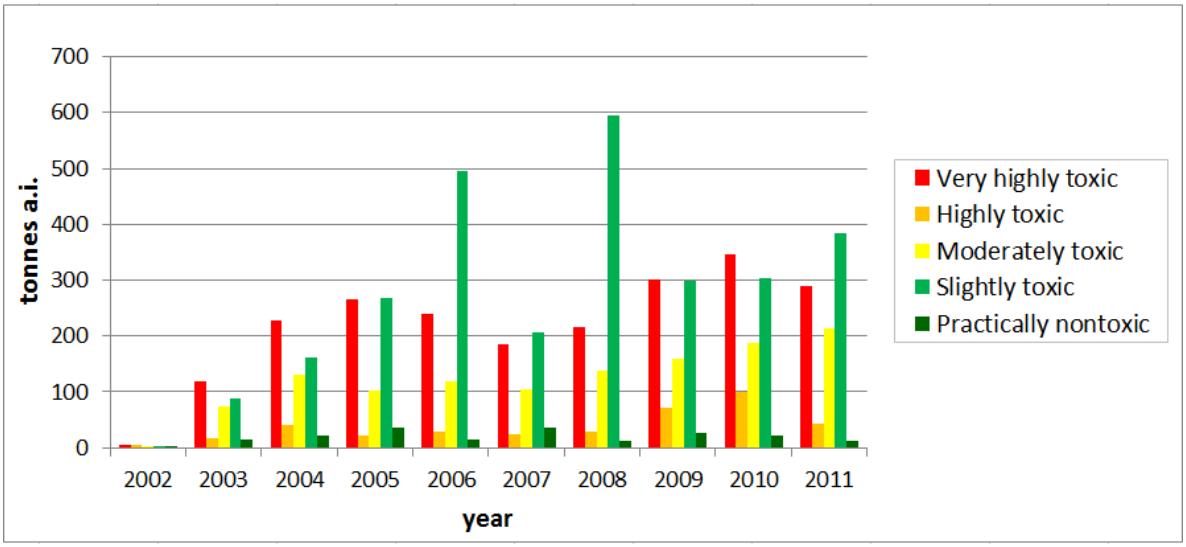

Figure 34: The annual volume of imported active ingredients per algae toxicity class in the period 2002-2011 (tonnes).

3.5.4 Bees

The annual number of active ingredients per bee toxicity class is shown in Figure 35. The relative imported numbers of a.i. that are slightly or very slightly toxic to bees is higher than for the aquatic organisms in the previous paragraphs, i.e., these two classes represent more than half of the imported a.i.

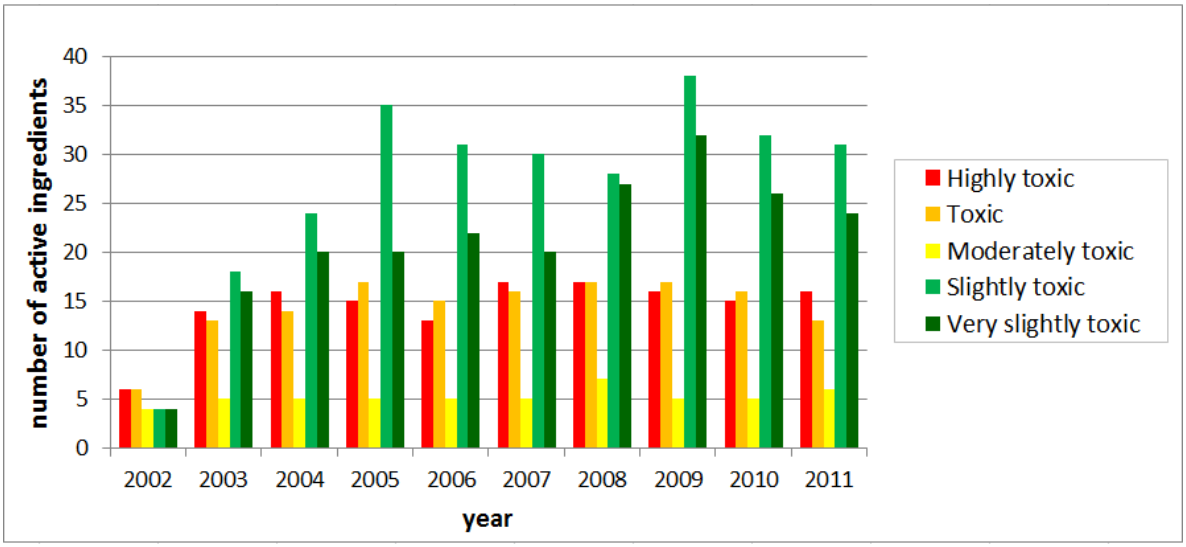

Figure 35: The annual number of imported active ingredients per bee toxicity class in the period 2002-2011.

The annual volume of active ingredients per bee toxicity class is shown in Figure 36. In terms of imported volume the a.i. that are slightly to very slightly toxic are even more represented, more than 75% in most years and increasing.

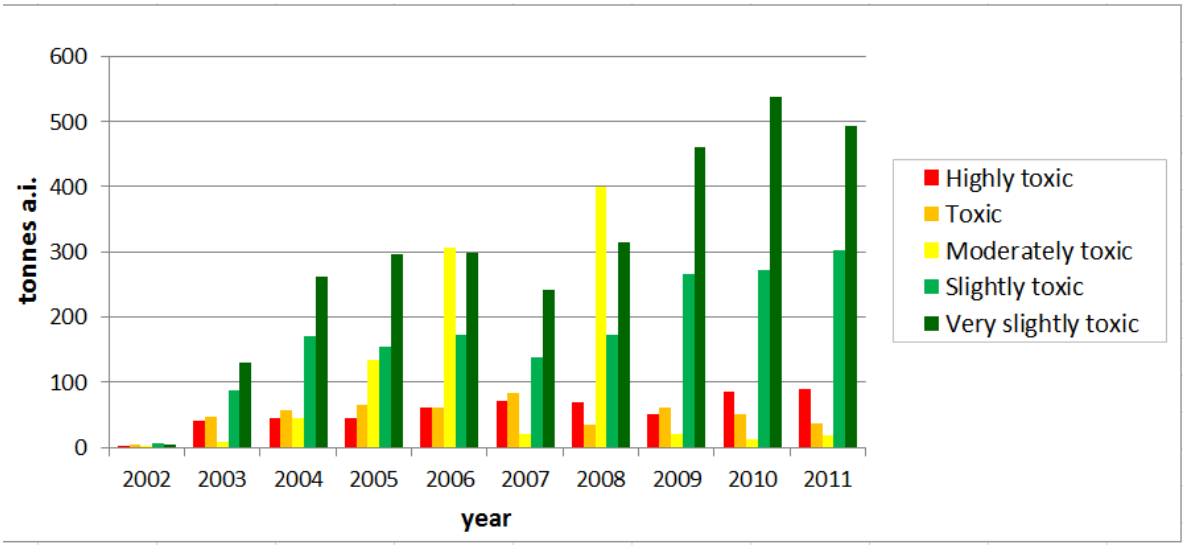

Figure 36: The annual volume of imported active ingredients per bee toxicity class in the period 2002-2011 (tonnes).

3.6 Environmental Toxic Load

The Environmental Toxic Load (ETL) indicators are calculated according to Equation 3 and presented in figures as the annual sum of all active ingredients imported. Compounds with the major contribution to the ETL are mentioned in the text. Annex 3 contains tables with the relative contributions of the 175 active ingredients to the total indicator values.

3.6.1 Fish

The annual Environmental Toxic Load for fish is shown in Figure 37. This indicator shows more changes over time than can be seen in the classification of imported numbers (Figure 29) and volumes (Figure 30) of active ingredients. The ETL for fish increases from 2002 to 2004 and peaks in 2010. In 2011 the ETL value is more than halved compared to 2010.

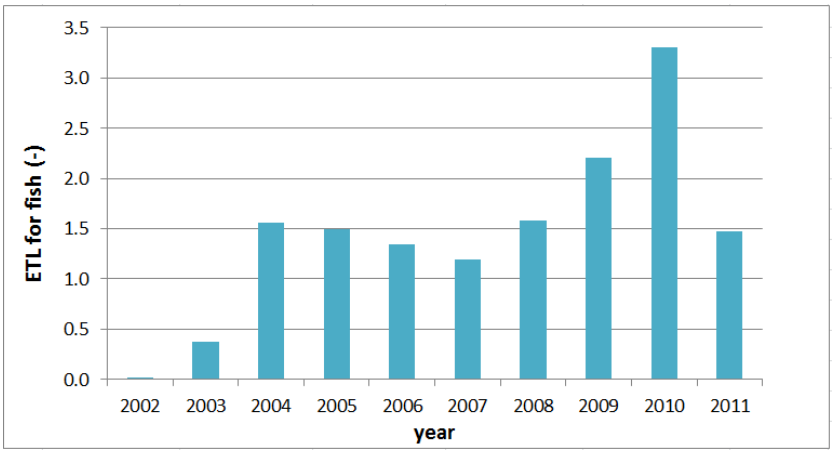

Figure 37: The annual Environmental Toxic Load for fish of active ingredients imported in Mozambique in the period 2002-2011.

Over the years one compound explains 50% or more of the total ETL for fish in more than two years (Table 3.1, Annex 3), lambda-cyhalothrin (trade names: Cyclon, Demand, Duduthrin Fortis, Icon, Iconet, Karate, Moz Lambda-cyhalothrin, Revival, Zakaka, Zakanaka, see Annex 5). It is therefore of primary concern. From 2005 to 2011 lambda-cyhalothrin was solely responsible for more than 80% of the ETL value (with the exception of 2007: 67%). The ETL peak value in 2010 is also explained by lambda-cyhalothrin. Active ingredients of secondary concern for fish are aluminium phosphide, chlorpyrifos, cyfluthrin, cypermethrin and endosulfan.

3.6.2 Aquatic invertebrates

The annual Environmental Toxic Load for the water flea *Daphnia* is shown in Figure 38. The ETL for *Daphnia* also increases initially, but from 2004 to 2011 it fluctuates between 3.0 and 7.0. It is considerably reduced in 2011 compared to 2010.

Over the years ETL values are determined by a limited number of active ingredients (Table 3.2 in Annex 3). They are mainly organophosphate compounds and synthetic pyrethroids: chlorpyrifos, cypermethrin, DDT (DDT, again, only in 2005, 2006 and 2008), dichlorvos, ethion, fenvalerate, lambda-cyhalothrin and pirimiphos-methyl. These active ingredients did not explain more than 50% of the ETL value in 2 years or more, but only >10% in one year or more. They are therefore categorised as of secondary concern for aquatic invertebrates according to the criteria set out in §2.4.

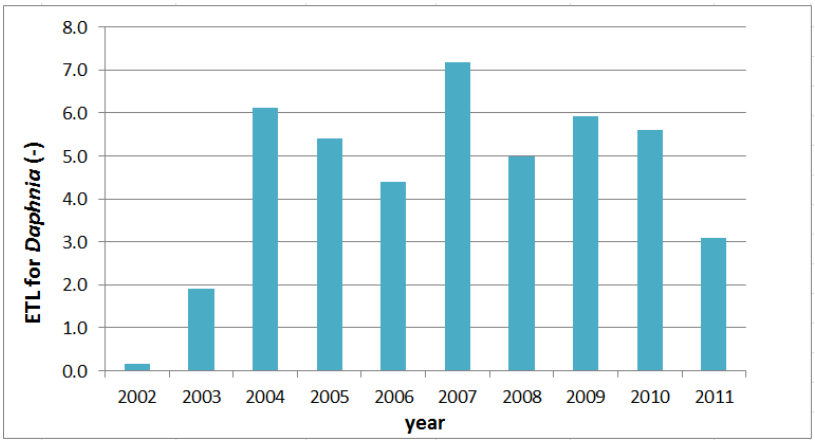

Figure 38: The annual Environmental Toxic Load for *Daphnia* of active ingredients imported in Mozambique in the period 2002-2011.

3.6.3 Algae

The annual Environmental Toxic Load for algae is shown in Figure 39. The toxic load of the imported active ingredients to algae increases from 2002 to 2005, decreases in 2006 and 2007 and increases again the following years. The pattern closely resembles the pattern observed for the total volume of pesticide products imported in Mozambique over the same period (Figure 7).

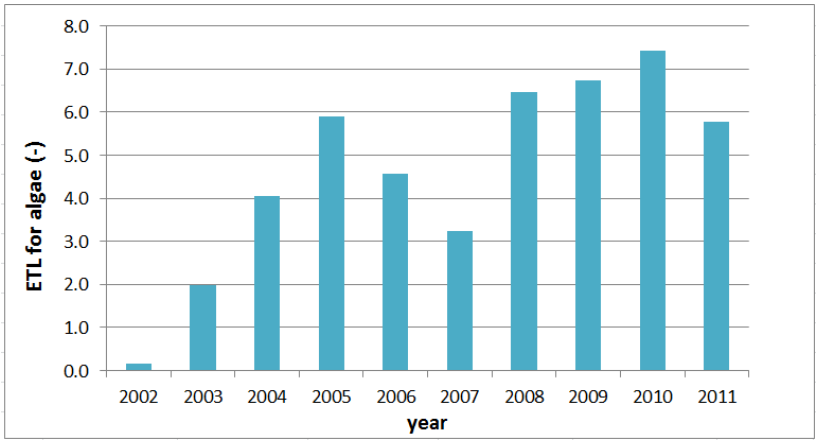

Figure 39: The annual Environmental Toxic Load for algae of active ingredients imported in Mozambique `in the period 2002-2011.

In all years, except 2002, 69% to 85% of the ETL value for algae is caused by the import of the a.i. acetochlor (Table 3.3, Annex 3). This is the only active ingredient of primary concern to algae. Trade names are Acetochlor, Bullet, Villa and Volcano (Annex 5). Paraquat contributes 5%-21% from 2003 to 2011 and 99% in 2002. The third a.i. that causes a potential hazard for algae is ametryn, which explains 4%-12% of the ETL yearly from 2003 to 2011. Both compounds represent > 10% of the ETL in more than one year and are therefore classified as of secondary concern.

3.6.4 Bees

The annual Environmental Toxic Load for bee is shown in Figure 40. The ETL increases considerably from 2002 to 2008 and then drops again. From 2009 to 2011 it remains at almost the same level of 0.07-0.08.

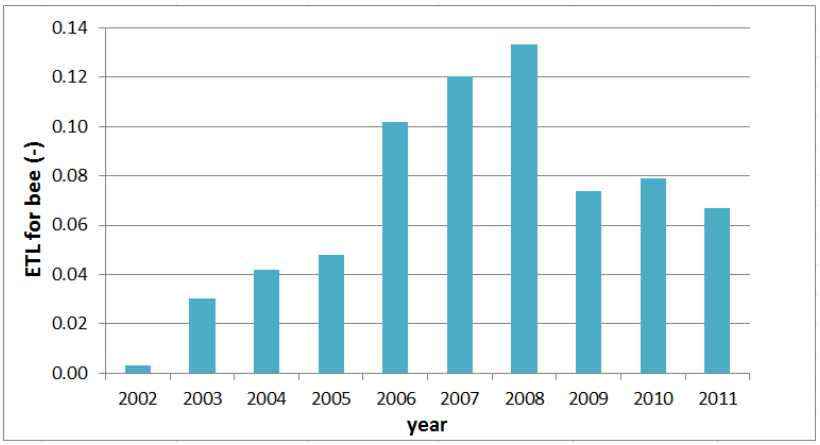

Figure 40: The annual Environmental Toxic Load for bees of active ingredients imported in Mozambique in the period 2002-2011.

The active ingredients that together determine most of the ETL values for bees vary considerably from year to year without any consistent trends in time (Table 3.4, Annex 3). One active ingredient constitutes >50% of the ETL value in more than 2 years and is of primary concern for bees, imidacloprid (trade names: Bandit, Condifor, Courag, Gaucho, Imidabiogel, Imidacel, Imidagold, Maxforce Quantum, Midaclordan, Monceren, Moz Imidacloprid, Premise, Protect, Quick Bait Spray Fly Bait, Seed Plus and Thunder, see Annex). The a.i. that are of secondary concern are bendiocarb, chlorpyrifos, cyfluthrin, cypermethrin, deltamethrin, lambda-cyhalothrin, profenofos and thiamethoxam.

3.7 Groundwater leaching potential

The calculated GUS indicator and the groundwater leaching potential class of the active ingredients in the imported products is listed Table 4.1 in Annex 4. The annual number of active ingredients per groundwater leaching potential class is shown in Figure 41. Over the whole period most imported a.i. have a low to very low leaching potential. Relative numbers in the different classes change little over time.

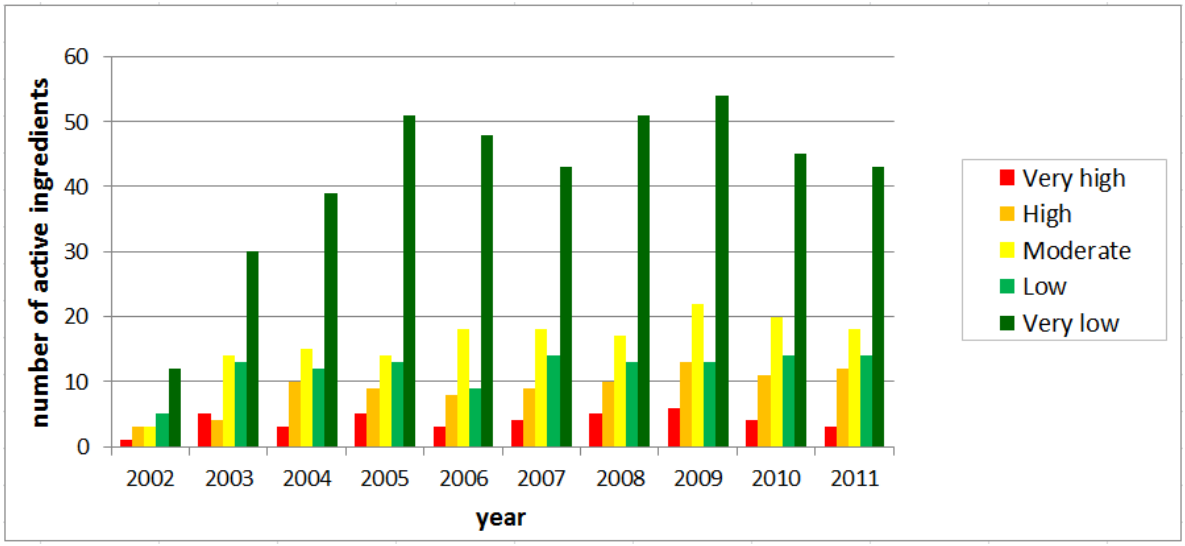

Figure 41: The annual number of imported active ingredients per groundwater leaching potential class in the period 2002-2011.

The annual volume of active ingredients per groundwater leaching potential class is shown in Figure 42. In terms of imported volume the a.i. with a moderate leaching potential are more important than in terms of imported numbers of a.i. (Figure 41), but the volumes of a.i. with a high or very high leaching potential are small. The two peaks of imported pesticides with a very low leaching potential in 2006 and 2008 are caused by DDT that strongly absorbs to particles and organic matter (GUS: -4.5).

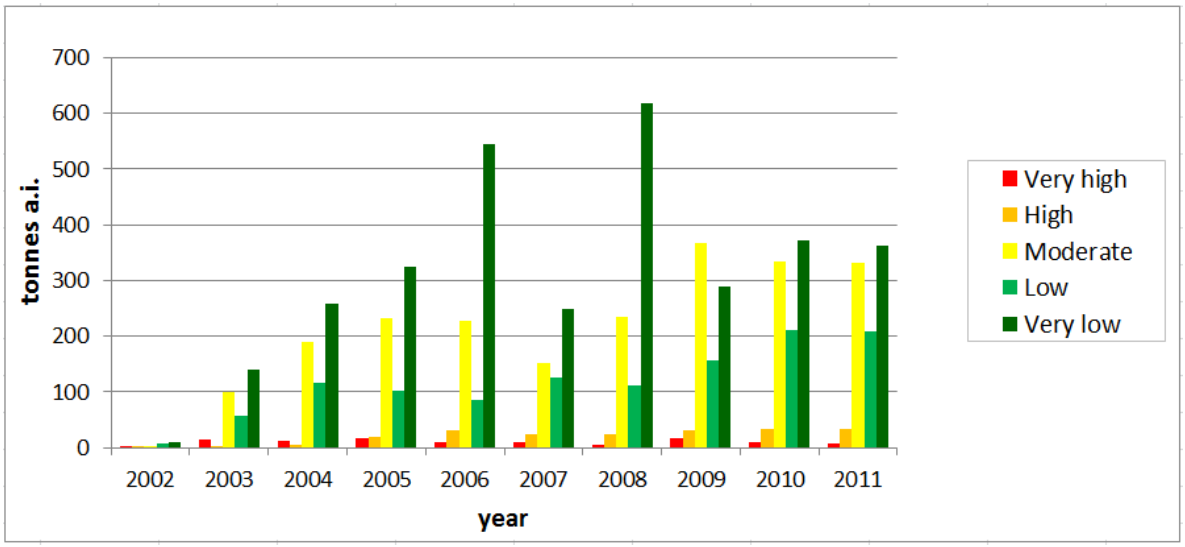

Figure 42: The annual volume of imported active ingredients per groundwater leaching potential class in the period 2002-2011 (tonnes).

The percentage of the total yearly imported volumes of active ingredients with a very high (Class 5) or high (Class 4) potential to leach to the groundwater are listed in Table 4.2 in Annex 4. Compounds of primary concern, i.e., Class 5 a.i. that constitute more than 1% of the total imported volume in two years or more, are methyl bromide (trade name: Volcano) and tebuthiuron (Volcano, Volcano Bundu). Of secondary concern are Atrazine (Class 4), Clomazone (Class 4), Hexazione (Class 5), Imidacloprid (Class 4) and Propoxur (Class 4).

4 Discussion

This chapter summarizes and discusses the main findings of the study. First the limitations of the methods are discussed. Secondly the trends in time of pesticide use, hazards and the Environmental Toxic Loads (ETLs) are analysed.[2]

4.1 Limitations and advantages of the methods

4.1.1 Use of import data

The analyses, trends and calculated indicators reported in this report are entirely based on import data. It is implicitly assumed that import data can be used as a surrogate for actual usage data when the potential hazards of formulated products and active ingredients are assessed. The assumption in that case would be that imported compounds are applied in the field in the same year that they are imported. It must be well understood that this is not the case in reality. Imported pesticide products may not be sold immediately, and if they are sold they may not be applied instantly. The actual hazards and risks of the use of the imported pesticides may well occur later and will depend on the actual use pattern, i.e., all applied within a short period or applied in portions over larger periods. We do, however, know that all imported pesticides are actually used in Mozambique and are not further exported.

There was no background information available to interpret several conspicuous observations such as the limited number of import events in the years 2002 and 2003, and for particular products, the large fluctuations of the volumes imported in subsequent years. An example is the imported volume of products based on DDT which alternately showed high import peaks in some years and absence of imported volumes in others.

Because import data were used in this report as a proxy for data on actual national use, care must be taken when interpreting and communicating the findings of the study.

4.1.2 Hazard assessments

The hazard assessments for aquatic organisms, groundwater and bees that were done during this study rank pesticides relative to each other from high to low hazard. The hazard assessments do not provide information on the actual risks in the field posed by these pesticides. Real risks to aquatic organisms, bees and groundwater depend on both the toxicity of the pesticide and the actual exposure of organisms to the pesticide. Exposure is, among other things, determined by pesticide formulation, soil properties, climate, application regimes, conditions during application, persistence of pesticides in the ecosystem, the presence and distance to surface water bodies, presence of fish and bees, buffer strips and other mitigation techniques employed, etc. These factors were not taken into account. Hazard assessments such as these, however, can be used to decide whether follow-up risk assessments are required.

The risk of judging pesticides on the basis of hazard assessment only is that farmers may be encouraged to base their choice of pesticide on only one parameter — low toxicity — without due consideration being taken into account of the overall risk, which requires the total exposure to also be considered. While, for pesticides with a low toxicity, repeated use may lead to increased exposure and therefore pose a higher risk than pesticides with a high toxicity but low rates of exposure. Therefore

[2] Parts of this discussion, especially about the methods, is the same as for the exercise that was done for pesticides used in cotton (De Blécourt et al., 2010). In these cases we have copied parts of this report and only slightly modified them (§4.1.2, §4.1.3).

drawing conclusions on hazard indicators only is not advised and it is recommended to use a simplified risk assessment method, for example PRIMET (Peeters et al., 2008).

The hazard assessments for aquatic organisms do not take into account the persistence of the compound. Highly toxic pesticides with a low persistence in the ecosystem can pose a lower risk to aquatic organisms than persistent compounds with lower toxicity. The approach could in the future be improved by including persistence and use patterns in the equation.

The hazard assessments for groundwater take into account mobility and degradation in soil, but not toxicity of the pesticides. Whether the use of a specific compound is a risk to groundwater depends on the toxicity of the compound, the distance to groundwater and the use of the groundwater. The hazard assessment for groundwater can be improved by including toxicity in the indicator.

4.1.3 Environmental Toxic Load

Environmental Toxic Load (ETL) indicators were used to evaluate the consequences of changes in pesticide use on average toxic loads to the environment. The ETL was calculated separately for fish, aquatic invertebrates (*Daphnia*), algae and bees. The ETL gives an indication of the average amount of toxic pressure applied on one (1) hectare of agricultural land in one (1) year. The ETL indicator combines the average amount of pesticides applied in the total agricultural area of the country with the toxicity of the active ingredients used. The actual exposure to the pesticide is not included in the ETL because this would require modelling. The ETL, therefore, is not an indicator of the risk associated with the use of a pesticide, or the actual impact on organisms in the field, but rather the ETL is a composed indicator for the relative hazard based on pesticide imports. For example, the active ingredient of an imported pesticide may be toxic to bees and increase the ETL value. But when it is a granular formulation and the pesticide is non-systemic, bees may never be exposed.

The ETL is used to compare average toxic loads to the environment (1) between pesticides, (2) between years and (3) in the case of the aquatic toxicity also between different groups of aquatic species (fish, water fleas and algae). As the ETL is averaged over the whole agricultural area, the ETL does not account for differences between regions where relatively high or low amounts of toxic substances are used. So even when the ETL is relatively low for a country in a given year, there could still be environmental risks in a particular area where a highly toxic active ingredient is used extensively.

4.1.4 GUS index

The GUS index has limited data needs and should be considered as a simple indicator of the groundwater leaching potential. It takes into account the persistence (degradation half-life) and mobility (sorption coefficient to soil organic carbon) of active ingredients. The leaching potential of metabolites is not considered, although some of these compounds pose greater hazards than their precursor. In addition, pH dependent sorption is not considered in the GUS. Using a combined sorption coefficient for calculating the GUS for soils with different pH, would result in a shift to a higher groundwater leaching potential class. For these reasons, the results of the analysis of the groundwater leaching potential of the imported active ingredients should be interpreted with some care.

4.1.5 Advantages of hazard analysis

In the previous paragraphs especially the limitations of the methods and indicators were discussed. However, the hazard-based method and the ETL also have certain advantages over more complex risk-based indicators. The amount of parameters needed for the analyses is limited. This is an advantage in developing countries where adequate data on pesticide use and exposure may often be very difficult to obtain. Furthermore, the methods are very suitable for trend analysis because data are analysed in a uniform way. Finally, these analyses are relatively cheap and fast. When time and budget are limiting factors their use will quickly provide some general insights which allows for a more focussed risk assessment as a follow-up.

4.2 Trends in pesticide imports

In this study trends in pesticide imports and hazards were assessed over a ten year period, from 2002 to 2011. During these years the total agricultural area of Mozambique, as reported by FAOSTAT, only very slightly increased (1.4%). Agricultural production, i.e., harvests that were reported for the various crops grown in the country, increased 40%, from 10 million tonnes in 2002 to 14 million tonnes in 2011. Because the total agricultural area only changed little during the same period, it must be concluded that on the whole agriculture in the country must have intensified.

This assumed intensification is reflected in the trend of the total volume of pesticides imported in the country. Imports were lowest in 2002, but it is not clear if the import data that were compiled for this year are complete. However, from 2003 to 2011 the imported total volume of formulated pesticides also increased considerably, from some 670 tonnes in 2003 to more than 2,500 tonnes in 2010 and 2011 (there was a temporary decrease in 2007). The number of active pesticide importers also increased over the study period, from a mere 5 in 2002 to more than 15 in 2011. The number of active importers temporarily declines around 2007, which could perhaps explain part of the reduced pesticide imports observed around the same time. Over the 10 year period one importer, Agrifocus Lda, is responsible for almost two thirds of the total imported volume of pesticide products.

The type of pesticides imported in Mozambique is very consistent over time. The majority of products consists of insecticides, followed by the herbicides and fungicides. The imported amounts of other type of pesticides such as rodenticides, nematicides, molluscicides and growth regulators is relatively small.

The trends in the imported volumes of active ingredients will be discussed in terms of their potential hazards in the following paragraphs. In general it could be observed that some older and very noxious active ingredients like methyl bromide may have been phased out already because they are not imported in later years. Other compounds keep on being used. The import data for 2005, 2006 and 2008 for example show some conspicuous peaks for DDT (Figure 13) which are repeatedly reflected by some of the human health and environmental indicators.

4.3 Human health hazard

The acute human health hazard of the pesticides imported in Mozambique was evaluated using the WHO classification for formulated pesticide products. Whereas the total volume of imported pesticides increased from 2002 to 2011, the fraction of highly hazardous products of the imported volume decreased and the fraction of products with a (very) low hazard increased. Over the period 9 active ingredients of primary concern (in Class 1b products) were imported, but mostly in rather limited quantities. Pesticide products containing aluminium phosphide were the most consistently imported Class Ib products over the 10-year period. However, some Class II products were imported in larger volumes and therefore of secondary concern. These contained active ingredients of secondary concern such as ametryn, DDT and more recently lambda-cyhalothrin.

Only few pesticide products with a known chronic hazard were imported in the country although imported volumes may still range from several tens to several hundred tonnes of the active ingredients. Compounds of primary concern are mancozeb and diuron (both carcinogenic), dichlorvos (also carcinogenic) is of secondary concern.

4.4 Environmental hazard

A considerable number of the pesticides imported into Mozambique are acutely toxic to fish, aquatic invertebrates, algae and to bees. However, the less hazardous pesticides represent a much higher volume of imports. For all four groups of species, the volume of slightly toxic or very slightly toxic active ingredients is highest. There are no clearly observable trends in time in environmental hazard of the imported products. Numbers and imported volumes for all toxicity classes increase as a

consequence of increasing imports, but there are no clear trends towards the import of more hazardous or less hazardous active ingredients in time.

The picture is somewhat different when the environmental toxic load is evaluated. This indicator corrects for the total agricultural area and cumulates the relative hazards of all imported active ingredients. All calculated ETL values increase during the first three or four years of the 10-yr. period. In other words, because more pesticides are imported per hectare of arable land, the potential environmental hazard increases (assuming that these pesticides are actually used). After this initial period the trends are slightly different.

The ETL for fish fluctuates around 1.5 from 2004 to 2008 and then suddenly increases in 2009 and 2010. In 2011 the ETL is back at c. 1.5 (Figure 37). During the first years many active ingredients that are well known to be very toxic to fish contribute to the ETL value (endosulfan, chlorpyriphos etc.). In the later years the ETL is for a very large part the result of the import of lambda-cyhalothrin (only compound classified as of primary concern). This pesticide is also responsible for the ETL peak values.

The relative hazard for aquatic invertebrates (*Daphnia*) also fluctuates but decreases in 2011 (Figure 38). The ETL usually depends on a combination of several organophosphate and synthetic pyrethroid compounds, but in changing combinations. Over the last four years, chlorpyrifos and lambda-cyhalothrin are major contributors to the hazard. DDT hazard to *Daphnia* peaks in 2006 and 2008.

The relative hazard to algae follows a trend that is similar as for *Daphnia*: an initial increase followed by a dip in 2007, an increase again and a slight decrease in 2011 (Figure 39). Acetochlor is responsible for a major part of the ETL value (of primary concern), followed by paraquat and ametryn (of secondary concern).

Because the indicators are based on a similar kind of data, The ETL values for fish, *Daphnia* and algae can be compared among each other. The ETL values for *Daphnia* and algae are of the same order of magnitude, i.e., 3-7 from 2004 to 2011. The value for fish is more than two times lower, c. 1-3 in the same years. These observations may be explained by the fact that more insecticides than herbicides are imported in Mozambique and that in general insecticides are more toxic to aquatic invertebrates than to fish, and that herbicides are more toxic to algae than to aquatic invertebrates or fish.

The ETL for bees, and thus the relative hazard of the imported pesticides, increases steadily from 2002 to 2006 before dropping to half the peak value in 2009. From 2009 to 2011 it stays at the same level (Figure 40). The ETL is the result of a suite of different insecticides, among which imidacloprid figures most prominently (of primary concern).

The groundwater leaching potential of the active ingredients imported in Mozambique is not very high. The hazard of the majority of the imported a.i. is classified as moderate to very low. The a.i. with the highest leaching potential are methyl bromide and tebuthiuron (of primary concern).

5 Conclusions

The most significant observations according to this study are:

- The volume of pesticides imported increased almost threefold, from 670 tonnes in 2003 to 2592 tons in 2011. Agricultural production increased by 40 % from 9.9 million tonnes in 2002 to 13,9 million tonnes in 2011, whereas the agricultural area increased only by 1.4%;
- The types of pesticides imported in the country are very consistent over time. The majority of products consists of insecticides, followed by the herbicides and fungicides;
- The volume of highly hazardous products imported over time decreased and the volume of products with a (very) low hazard increased;
- Only few pesticide products with a known chronic hazard to human health were imported in the country, although carcinogenic products were imported at the rate of 100 tons per year;
- A considerable number of the pesticides imported into the country are acutely toxic to fish, aquatic invertebrates, algae and bees. However, the less hazardous pesticides represent a much higher volume of imports;
- The Environmental Toxic Load (ETL) (relative hazard corrected for surface of agricultural area) to aquatic organisms (fish, aquatic invertebrates and algae) increases from 2002 to 2010, but decreases for all three groups of species in 2011;
- Overall, the hazard of the imported pesticides is more than two times higher to aquatic invertebrates and algae than to fish;
- The ETL to bees also increases from 2002 to 2008, but is considerably lower from 2009 to 2011;
- Only few active ingredients with a very high or high leaching potential are imported in the country.

The pesticides that contributed most to the overall human health hazards and environmental hazards are given in Table 6. Active ingredients of primary or secondary concern were identified the criteria set out in §2.4. These criteria combine both potential hazard of the pesticides and imported quantities in Mozambique. Annex 5 provides the volumes of the all formulated pesticides imported in Mozambique that contain active ingredients of primary concern for all years of the period 2002-2011. These tables may be used for specific hazard reducing measures. Such tables may also be generated for pesticides of secondary concern or for any other pesticide of interest using the pivot table that is provided with the revised spreadsheet containing the Pesticide Import data.

Three things must be noted in respect to this Table: 1) pesticides with a low toxicity and a high environmental persistence are not considered. Such pesticides may even represent a bigger threat to the environment than highly toxic pesticides with a low environmental persistence; 2) the Environmental Toxic Loads are based on import data and do not account for any regional variations in use, e.g. extensive use of highly toxic pesticides in a particular area; 3) none of the classifications of pesticide active ingredients as of primary or secondary concern was based on estimated properties (see §2.1.2).

One final and general recommendation is that records of pesticide import volumes and relevant properties, including the active ingredients, can be analysed much more efficiently when the data are organised in a database environment. A database structure is needed in order to define the relations between products and compounds, and to maintain the integrity of the data that will be entered. If similar exercises are planned for Mozambique or other countries in the future, designing and setting up such a database would proof a very fruitful investment.

Table 6: Pesticides imported in Mozambique from 2002 to 2011 that are of concern in terms of potential human health and environmental hazard and annually imported quantity (for criteria, see §2.4).

Type of hazard	Pesticide active ingredient of primary concern	Pesticide active ingredient of secondary concern
Human health		
Acute (WHO classification)	Class I pesticide products containing: Abamectin Aldicarb Aluminium phoshide Fenamiphos Methomyl Mevinphos Monocrotophos Oxamyl Terbufos	Class II pesticide products containing: Ametryn DDT Lambda-cyhalothrin
Chronic	Diuron (carcinogenic) Mancozeb (carcinogenic)	Dichlorvos (carcinogenic)
Environment		
Fish	Lambda-cyhalothrin	Aluminium phoshide Chlorpyrifos Cyfluthrin Cypermethrin Endosulfan
Aquatic invertebrates	-	Chlorpyrifos Cypermethrin DDT Dichlorvos Ethion Fenvalerate Lambda-cyhalothrin Pirimiphos-methyl
Algae	Acetochlor	Ametryn Paraquat
Bees	Imidacloprid	Bendiocarb Chlorpyrifos Cyfluthrin Cypermethrin Deltamethrin Lambda-cyhalothrin Profenofos Thiamethoxam
Leaching to groundwater	Methyl bromide Tebuthiuron	Atrazine Clomazone Hexazione Imidacloprid Propoxur

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Annexes

1. Compound properties
2. Hazard to human health
3. Environmental toxic load
4. Groundwater leaching

Annex 1: Compound properties

Compound properties
Tables with the properties of the active ingredients in the imported products, 2002-2011;

1. Sources
2. Fate
3. Toxicity

Table 1.1: Source of fate and toxicity properties of the 175 active ingredients in the imported products, 2002-2011.

Source	Code (Table 2, 3)	DegT50	Koc	EC50 algae	EC50 Daphnia	EC50 fish	LD50 bee	LD50 rat
FootPrint	FP	54	138	131	145	143	135	55
FAO HHP	HHP	33						95
NMI 3	NMI	57						
Alterra ERA	ERA		1	1		1		
Mean value chemical class	CC	13	11	21	19	13	16	15
Mean value product group	PG	18	25	22	11	18	24	10

Table 1.2: Fate properties of the 175 active ingredients in the imported products, 2002-2011.

Nr.	Cas-Nr.	CompoundName	Chemical class	Product group	DegT50 (d)	source	Koc (L/kg)	source
1	94-75-7	2,4-D	aryloxyalkanoic acid	herbicide	16	NMI	88.4	FP
2	2008-39-1	2,4-D dimethylamine	aryloxyalkanoic acid	herbicide	19	CC	81.2	CC
3	71751-41-2	Abamectin	avermectin	insecticide	29	NMI	14000	FP
4	30560-19-1	Acephate	organophosphate	insecticide	3	HHP	302	FP
5	135410-20-7	Acetamiprid	neonicotinoid	insecticide	3	FP	200	FP
6	-999	Acetic acid + ammonia	organic acid	herbicide	160	PG	24379	PG
7	34256-82-1	Acetochlor	chloroacetamide	herbicide	14	FP	156	FP
8	15972-60-8	Alachlor	chloroacetamide	herbicide	14	FP	335	FP
9	116-06-3	Aldicarb	carbamate	insecticide	5	NMI	36	FP
10	67375-30-8	Alpha-cypermethrin	pyrethroid	insecticide	35	FP	57889	FP
11	20859-73-9	Aluminium phosphide	inorganic compound	insecticide	0	FP	2701	CC
12	834-12-8	Ametryn	triazine	herbicide	37	HHP	316	FP
13	129909-90-6	Amicarbazone	triazolinone	herbicide	21	FP	51.7	FP
14	33089-61-1	Amitraz	amidine	insecticide	0	HHP	1000	FP
15	1912-24-9	Atrazine	triazine	herbicide	58	NMI	100	FP
16	131860-33-8	Azoxystrobin	strobilurin	fungicide	94	NMI	589	FP
18	68038-71-1	Bacillus thuringiensis	biopesticide	insecticide	19	CC	191989	PG
19	22781-23-3	Bendiocarb	carbamate	insecticide	4	FP	385	FP
20	17804-35-2	Benomyl	benzimidazole	fungicide	0	NMI	1900	FP
21	83055-99-6	Bensulfuron-methyl	sulfonylurea	herbicide	24	FP	370	FP
22	25057-89-0	Bentazone	benzothiazinone	herbicide	37	NMI	55.3	FP
23	68359-37-5	Beta-cyfluthrin	pyrethroid	insecticide	13	FP	64300	FP
24	56073-10-0	Brodifacoum	hydrocoumarin	other	157	HHP	86200	FP
25	314-40-9	Bromacil	uracil	herbicide	60	FP	32	FP
26	1689-99-2	Bromoxynil octanoate	hydroxybenzonitrile	herbicide	1	FP	639	FP
27	41483-43-6	Bupirimate	pyrimidinol	fungicide	151	NMI	767	FP

28	33629-47-9	Butralin	dinitroaniline	herbicide	22	FP	46391	FP
29	133-06-2	Captan	phthalimide	fungicide	1	NMI	200	FP
30	63-25-2	Carbaryl	carbamate	insecticide	16	FP	300	FP
31	10605-21-7	Carbendazim	benzimidazole	fungicide	71	NMI	400	FP
32	1563-66-2	Carbofuran	carbamate	insecticide	17	NMI	22	FP
33	55285-14-8	Carbosulfan	carbamate	insecticide	21	FP	9489	FP
34	5234-68-4	Carboxin	oxathiin	fungicide	0	FP	99.4	FP
35	470-90-6	Chlorfenvinphos	organophosphate	insecticide	62	NMI	680	FP
36	99283-00-8	Chlorimuron	sulfonylurea	herbicide	17	CC	205	CC
37	1897-45-6	Chlorothalonil	chloronitrile	fungicide	14	NMI	850	FP
38	2921-88-2	Chlorpyrifos	organophosphate	insecticide	50	FP	8151	FP
39	5598-13-0	Chlorpyrifos-methyl	organophosphate	insecticide	81	NMI	4645	FP
40	8000-29-1	Citronella oil	unclassified	other	136	PG	7721846	PG
41	81777-89-1	Clomazone	isoxazolidinone	herbicide	111	NMI	300	FP
42	13822-80-5	Copper ammonium acetate	inorganic compound	fungicide	4402	CC	4657	CC
43	20427-59-2	Copper hydroxide	inorganic compound	fungicide	10000	HHP	12000	FP
44	1317-39-1	Copper oxide	inorganic compound	fungicide	10000	HHP	2701	CC
45	1332-40-7	Copper oxychloride	inorganic compound	fungicide	10000	HHP	4657	CC
46	101205-02-1	Cycloxydim	cyclohexanedione oxime	herbicide	1	NMI	59	FP
47	68359-37-5	Cyfluthrin	pyrethroid	insecticide	0	NMI	123930	FP
48	57966-95-7	cymoxanil	cyanoacetamide oxime	fungicide	1	NMI	145	FP
49	52315-07-8	Cypermethrin	pyrethroid	insecticide	60	FP	156250	FP
50	66215-27-8	Cyromazine	triazine	insecticide	32	NMI	765	FP
51	584-79-2	D-allethrin	pyrethroid	insecticide	60	HHP	2414	FP
52	533-74-4	Dazomet	dithiocarbamate	other	0	NMI	10	FP
53	50-29-3	DDT	organochlorine	insecticide	6200	FP	260324	FP
54	11-30-1	Decanol	organic alcohol	other	136	PG	7721846	PG
55	52918-63-5	Deltamethrin	pyrethroid	insecticide	30	HHP	1.0E+07	FP
56	333-41-5	Diazinon	organophosphate	insecticide	49	NMI	609	FP
57	62-73-7	Dichlorvos	organophosphate	insecticide	2	NMI	50	FP

58	7173-51-5	Didecyldimethylammonium chloride	quaternary ammonium compound	fungicide	1495	PG	1469081	ERA
59	134-62-3	Diethyltoluamide	benzamide	other	136	PG	478	FP
60	119446-68-3	Difenoconazole	triazole	insecticide	109	NMI	3760	FP
61	104653-34-1	Difethialone	coumarin anticoagulant	other	635	FP	54000000	FP
62	35367-38-5	Diflubenzuron	benzoylurea	insecticide	12	NMI	10000	FP
63	60-51-5	Dimethoate	organophosphate	insecticide	8	NMI	30.1	FP
64	330-54-1	Diuron	urea	herbicide	81	NMI	813	FP
65	115-29-7	Endosulfan	organochlorine	insecticide	50	FP	11500	FP
66	106325-08-0/133855-98-8	Epoxiconazole	triazole	fungicide	314	NMI	1802	FP
67	16672-87-0	Ethephon	ethylene generator	other	16	FP	2540	FP
68	563-12-2	Ethion	organophosphate	insecticide	90	FP	17240	FP
69	52304-36-6	Ethylbutylacetylaminopropionate	organic ester	other	136	PG	7721846	PG
70	106-93-4	Ethylene dibromide	brominated alkene	other	136	PG	7721846	PG
71	75-21-8	Ethylene oxide	organic epoxide	other	136	PG	7721846	PG
72	22224-92-6	Fenamiphos	organophosphate	insecticide	1	FP	100	FP
73	13356-08-6	Fenbutatin oxide	organotin	insecticide	95	HHP	183550	FP
74	122-14-5	Fenitrothion	organophosphate	insecticide	21	NMI	2000	FP
75	39515-41-8/64257-84-7	Fenpropathrin	pyrethroid	insecticide	28	HHP	5000	FP
76	55-38-9	Fenthion	organophosphate	insecticide	34	HHP	1500	FP
77	51630-58-1	Fenvalerate	pyrethroid	insecticide	35	HHP	5273	FP
78	120068-37-3	Fipronil	phenylpyrazole	insecticide	142	FP	577	FP
80	79241-46-6	Fluazifop-P-butyl	aryloxyphenoxypropionate	herbicide	3	NMI	3394	FP
81	69770-45-2	Flumethrin	pyrethroid	insecticide	26	CC	853297	CC
82	2164-17-2	Fluometuron	unclassified	herbicide	160	PG	24379	PG
83	69377-81-7	fluroxypyr	pyridine compound	herbicide	111	NMI	24600	FP
84	50-00-0	Formaldehyde	organic aldehyde	other	6	FP	37	FP
85	98-01-1	Furfural	heterocyclic aldehyde	other	1	FP	94.82	FP
86	1071-83-6	Glyphosate	glycine derivative	herbicide	17	NMI	1435	FP
87	135397-30-7	Halosulfuron	pyrimidinylsulfonylurea	herbicide	247	HHP	14141	PG
88	100784-20-1	Halosulfuron-methyl	pyrimidinylsulfonylurea	herbicide	14	HHP	109	FP

89	79983-71-4	Hexaconazole	triazole	fungicide	225	HHP	1040	FP
90	51235-04-2	Hexazinone	triazinone	herbicide	105	FP	54	FP
91	67485-29-4	Hydramethylnon	trifluoromethyl aminohydrazone	insecticide	7	HHP	730000	FP
92	104098-48-8	Imazapic	imidazolinone	herbicide	120	FP	137	FP
93	81334-34-1	Imazapyr	imidazolinone	herbicide	11	FP	125	FP
94	138261-41-3	Imidacloprid	neonicotinoid	insecticide	169	NMI	189	FP
95	72963-72-5	Imiprothrin	pyrethroid	insecticide	5	FP	402	FP
96	173584-44-6	Indoxacarb	oxadiazine	insecticide	17	NMI	6450	FP
97	141112-29-0	Isoxaflutole	isoxazole	insecticide	2	NMI	145	FP
98	91465-08-6	Lambda-cyhalothrin	pyrethroid	insecticide	25	FP	157000	FP
99	330-55-2	Linuron	urea	herbicide	47	NMI	739	FP
100	103055-07-8	Lufenuron	benzoylurea	insecticide	16	FP	41182	FP
101	121-75-5	Malathion	organophosphate	insecticide	1	HHP	1800	FP
102	8018-01-7	Mancozeb	dithiocarbamate	fungicide	18	HHP	998	FP
103	94-74-6	MCPA	aryloxyalkanoic acid	herbicide	22	NMI	74	FP
104	104206-82-8	Mesotrione	triketone	herbicide	16	NMI	122	FP
105	57837-19-1	Metalaxyl	phenylamide	fungicide	70	HHP	165	FP
106	70630-17-0	Metalaxyl-M	phenylamide	fungicide	216	NMI	660	FP
107	108-62-3	Metaldehyde	cyclo-octane	insecticide	8	NMI	240	FP
109	10265-92-6	Methamidophos	organophosphate	insecticide	2	NMI	1	FP
110	2032-65-7	Methiocarb	carbamate	insecticide	35	HHP	660	FP
111	16752-77-5	Methomyl	carbamate	insecticide	30	HHP	72	FP
112	74-83-9	Methyl bromide	inorganic compound	insecticide	55	FP	22	FP
113	2682-20-4	Methyl isothiazolin one	isothiozolinones	other	136	PG	7721846	PG
114	26172-55-4	Methylchoroisothiazolinone	isothiozolinones	other	136	PG	7721846	PG
115	51218-45-2	Metolachlor	chloroacetamide	herbicide	32	NMI	120	FP
116	21087-64-9	Metribuzin	triazinone	herbicide	12	FP	37.9	FP
117	74223-64-6	Metsulfuron-methyl	sulfonylurea	herbicide	10	FP	39.5	FP
118	7786-34-7	Mevinphos	organophosphate	insecticide	0	NMI	44	FP
119	-999	Mineral oil	unclassified	insecticide	132	PG	191989	PG

120	2212-67-1	Molinate	thiocarbamate	herbicide	12	HHP	190	FP
121	6923-22-4	Monocrotophos	organophosphate	insecticide	7	FP	32.8	FP
122	2163-80-6	Monosodium methyl arsenate	arsenate	herbicide	200	HHP	24379	PG
123	25154-52-3	Nonylphenol	alkylphenol	other	136	PG	7721846	PG
124	1003-07-2	Octylisothiazolinone	isothiozolinones	other	136	PG	7721846	PG
125	19666-30-9	Oxadiazon	oxidiazole	herbicide	502	FP	3200	FP
126	23135-22-0	Oxamyl	carbamate	insecticide	12	NMI	16.6	FP
127	42874-03-3	Oxyfluorfen	diphenyl ether	herbicide	35	FP	17636	FP
128	4685-14-7	Paraquat	bipyridylium	herbicide	2800	HHP	1000000	FP
129	66063-05-6	pencycuron	phenylurea	insecticide	32	HHP	6207	FP
130	40487-42-1	Pendimethalin	dinitroaniline	herbicide	90	FP	17581	FP
131	52645-53-1	Permethrin	pyrethroid	insecticide	42	HHP	100000	FP
132	26002-80-2	phenothrin	pyrethroid	insecticide	1	FP	310320	FP
133	13598-36-2	Phosphoric acid	inorganic compound	other	4402	CC	4657	CC
134	1918-02-1	Picloram	pyridine compound	herbicide	83	FP	13	FP
135	8002-09-3	Pine oil	biopesticide	herbicide	19	CC	24379	PG
136	51-03-6	Piperonyl butoxide	unclassified	insecticide	13	HHP	89125	FP
137	29232-93-7	Pirimiphos methyl	organophosphate	insecticide	22	NMI	1100	FP
138	23031-36-9	Prallethrin	pyrethroid	insecticide	26	CC	853297.5	CC
139	41198-08-7	Profenofos	organophosphate	insecticide	7	HHP	3476	FP
140	7287-19-6	Prometryn	triazine	herbicide	60	HHP	400	FP
141	709-98-8	Propanil	anilide	herbicide	0	FP	152	FP
142	2312-35-8	Propargite	sulfite ester	insecticide	56	FP	56500	FP
143	12071-83-9/9016-72-2	Propineb	dithiocarbamate	fungicide	3	FP	18	FP
144	114-26-1	Propoxur	carbamate	insecticide	35	NMI	51.72	FP
145	8003-34-7	Pyrethrins	unclassified	insecticide	132	PG	191989	PG
146	84087-01-4	Quinclorac	quinolinecarboxylic acid	herbicide	450	FP	50	FP
147	119738-06-6	Quizalofop-P-tefuryl	aryloxyphenoxypropionate	herbicide	0	FP	477	FP
150	87392-12-9/178961-20-1	S-Metolachlor	chloroacetamide	herbicide	20	NMI	2261	FP
151	168316-95-8	Spinosad	biopesticide	insecticide	31	NMI	34600	FP

152	99105-77-8	Sulcotrione	triketone	herbicide	12	NMI	36	FP
153	122836-35-5	Sulfentrazone	aryl triazolinone	herbicide	541	FP	43	FP
154	7704-34-9	Sulphur	inorganic compound	fungicide	30	FP	1950	FP
155	107534-96-3	Tebuconazole	triazole	herbicide	95	NMI	1554	FP
156	34014-18-1	Tebuthiuron	urea	herbicide	1300	HHP	80	FP
157	13071-79-9	Terbufos	organophosphate	insecticide	12	HHP	500	FP
158	5915-41-3	terbuthylazine	triazine	herbicide	105	NMI	220	FP
159	886-50-0	Terbutryn	triazine	herbicide	43	NMI	2432	FP
160	116-29-0	Tetradifon	bridged diphenyl	insecticide	112	FP	100	FP
161	7696-12-0	Tetramethrin	pyrethroid	insecticide	3	HHP	1423	FP
162	153719-23-4	Thiamethoxam	neonicotinoid	insecticide	53	NMI	56.2	FP
163	137-26-8	Thiram	dimethyldithiocarbamate	insecticide	6	NMI	670	FP
164	118712-89-3	Transfluthrin	unclassified	insecticide	132	PG	111362	PG
165	43121-43-3	Triadimefon	triazole	fungicide	26	FP	300	FP
166	55219-65-3	Triadimenol	triazole	fungicide	159	NMI	750	FP
167	52-68-6	Trichlorfon	organophosphate	insecticide	1	NMI	10	FP
170	55335-06-3	Triclopyr	pyridine compound	herbicide	35	NMI	27	FP
171	-999	Tricozene	unclassified	other	136	PG	7721846	PG
172	141517-21-7	Trifloxystrobin	strobilurin	fungicide	1	NMI	2377	FP
173	1582-09-8	Trifluralin	dinitroaniline	herbicide	181	FP	15800	FP
174	-999	Trifluthrin	pyrethroid	insecticide	26	CC	853297	CC
175	-999	Violeta Genciana	unclassified	insecticide	132	PG	191989	PG

Table 1.3: Toxicity of the 175 active ingredients in the imported products, 2002-2011.

Nr.	Compound Name	LD50 rat (mg)	source	LC50 fish (mg/L)	source	EC50 daphnia (mg/L)	source	EC50 algae (mg/L)	source	LD50 bee (µg/bee)	source
1	2,4-D	469	FP	63.4	FP	100	FP	24.2	FP	94	FP
2	2,4-D dimethylamine	585	CC	56.7	CC	145	CC	52	CC	147	CC
3	Abamectin	8.7	HHP	0.0036	FP	0.0001	FP	1.59	FP	0.0022	FP
4	Acephate	945	HHP	110	FP	67.2	FP	980	FP	1.2	FP
5	Acetamiprid	213	HHP	100	FP	49.8	FP	98.3	FP	8.09	FP
6	Acetic acid + ammonia	2782	PG	51.8	PG	92.4	PG	14.0	PG	88.6	PG
7	Acetochlor	2950	HHP	0.36	FP	8.6	FP	0.00027	FP	100	FP
8	Alachlor	930	HHP	1.8	FP	10	FP	0.966	FP	16	FP
9	Aldicarb	0.93	HHP	0.56	FP	0.42	FP	50	FP	0.09	FP
10	Alpha-cypermethrin	79	HHP	0.0028	FP	0.0003	FP	0.1	FP	0.033	FP
11	Aluminium phosphide	8.7	HHP	0.0097	FP	0.37	FP	0.058	FP	0.24	FP
12	Ametryn	110	HHP	5	FP	28	FP	0.0036	FP	100	FP
13	Amicarbazone	1015	HHP	120	FP	119	FP	14.0	PG	24.8	FP
14	Amitraz	800	HHP	0.74	FP	0.035	FP	12	FP	50	FP
15	Atrazine	2000	HHP	4.5	FP	85	FP	0.059	FP	100	FP
16	Azoxystrobin	5000	FP	0.47	FP	0.23	FP	0.36	FP	25	FP
18	Bacillus thuringiensis	3579	CC	171	PG	57	CC	45.09	PG	50	CC
19	Bendiocarb	55	HHP	1.55	FP	0.03	FP	1.71	FP	0.1	FP
20	Benomyl	10000	FP	0.17	FP	0.28	FP	2	FP	10	FP
21	Bensulfuron-methyl	5000	FP	66	FP	130	FP	0.02	FP	51.4	FP
22	Bentazone	1100	HHP	100	FP	64	FP	10.1	FP	200	FP
23	Beta-cyfluthrin	11	HHP	0.000068	FP	0.00029	FP	10	FP	0.001	FP
24	Brodifacoum	0.3	HHP	0.051	FP	0.98	FP	5.53	PG	62	PG
25	Bromacil	5200	HHP	36	FP	119	FP	0.013	FP	100	FP
26	Bromoxynil octanoate	238	FP	0.041	FP	0.046	FP	0.043	FP	100	FP

27	Bupirimate	4000	FP	1	FP	3.41	FP	1.6	FP	50	FP
28	Butralin	1049	HHP	0.37	FP	0.12	FP	0.12	FP	95.7	FP
29	Captan	2000	FP	0.186	FP	7.1	FP	1.18	FP	100	FP
30	Carbaryl	300	HHP	2.6	FP	0.0064	FP	0.6	FP	0.14	FP
31	Carbendazim	10000	FP	0.19	FP	0.15	FP	7.7	FP	50	FP
32	Carbofuran	8	HHP	0.18	FP	0.0094	FP	6.5	FP	0.036	FP
33	Carbosulfan	250	HHP	0.015	FP	0.0015	FP	47	FP	0.18	FP
34	Carboxin	2588	FP	2.3	FP	57	FP	0.48	FP	100	FP
35	Chlorfenvinphos	31	HHP	1.1	FP	0.00025	FP	1.36	FP	0.55	FP
36	Chlorimuron	4102	HHP	108	CC	140	CC	0.033	CC	38.2	CC
37	Chlorothalonil	5000	FP	0.038	FP	0.084	FP	0.21	FP	40	FP
38	Chlorpyrifos	135	HHP	0.0013	FP	0.0001	FP	0.48	FP	0.059	FP
39	Chlorpyrifos-methyl	2814	FP	0.41	FP	0.0006	FP	0.57	FP	0.11	FP
40	Citronella oil	4323	CC	2.65	CC	0.256	CC	0.17	CC	62	PG
41	Clomazone	1369	HHP	15.5	FP	12.7	FP	0.136	FP	85.3	FP
42	Copper ammonium acetate	1298	CC	1667	CC	167	CC	73.9	CC	62.1	CC
43	Copper hydroxide	1000	HHP	0.017	FP	0.038	FP	0.009	FP	44.5	FP
44	Copper oxide	300	FP	0.207	FP	0.45	FP	0.147	FP	116	FP
45	Copper oxychloride	1298	CC	1667	CC	167	CC	73.9	CC	62.1	CC
46	Cycloxydim	3900	HHP	220	FP	70.8	FP	74.9	FP	100	FP
47	Cyfluthrin	15	HHP	0.00047	FP	0.00016	FP	10	FP	0.001	FP
48	cymoxanil	1196	HHP	29	FP	27	FP	0.254	FP	85.3	FP
49	Cypermethrin	250	HHP	0.0028	FP	0.0003	FP	0.1	FP	0.02	FP
50	Cyromazine	3300	HHP	100	FP	100	FP	124	FP	186	FP
51	D-allethrin	685	HHP	19	FP	0.021	FP	8.5	CC	3.4	FP
52	Dazomet	415	FP	0.3	FP	19	FP	0.16	FP	24	FP
53	DDT	113	FP	7	FP	0.005	FP	45.1	PG	5	FP
54	Decanol	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
55	Deltamethrin	135	HHP	0.00026	FP	0.00056	FP	9.1	FP	0.0015	FP
56	Diazinon	300	HHP	3.1	FP	0.001	FP	6.4	FP	0.09	FP

57	Dichlorvos	56	HHP	0.55	FP	0.00019	FP	52.8	FP	0.29	FP
58	Didecyldimethylammonium chloride	150	HHP	1.16	FP	0.094	FP	0.66	ERA	88.3	PG
59	Diethyltoluamide	2000	HHP	71.3	FP	75	FP	5.53	PG	62	PG
60	Difenoconazole	1453	HHP	1.1	FP	0.77	FP	0.032	FP	100	FP
61	Difethialone	0.56	HHP	0.051	FP	0.0044	FP	0.18	FP	62	PG
62	Diflubenzuron	4640	FP	0.13	FP	0.0026	FP	20	FP	25	FP
63	Dimethoate	150	HHP	30.2	FP	2	FP	90.4	FP	0.12	FP
64	Diuron	3400	HHP	6.7	FP	5.7	FP	0.0027	FP	100	FP
65	Endosulfan	80	HHP	0.002	FP	0.44	FP	2.15	FP	7.81	FP
66	Epoxiconazole	3160	FP	3.14	FP	8.69	FP	1.19	FP	83	FP
67	Ethephon	1564	FP	100	FP	31.7	FP	20.9	FP	100	FP
68	Ethion	208	HHP	0.5	FP	0.000056	FP	88.3	CC	20.6	FP
69	Ethylbutylacetylaminopropionate	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
70	Ethylene dibromide	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
71	Ethylene oxide	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
72	Fenamiphos	15	HHP	0.0093	FP	0.0019	FP	3.8	FP	0.28	FP
73	Fenbutatin oxide	2630	HHP	0.00114	FP	0.048	FP	0.0036	FP	200	FP
74	Fenitrothion	503	FP	1.3	FP	0.0086	FP	1.3	FP	0.16	FP
75	Fenpropathrin	66	HHP	0.0023	FP	0.00053	FP	2	FP	0.05	FP
76	Fenthion	586	HHP	0.8	FP	0.0057	FP	1.79	FP	0.308	FP
77	Fenvalerate	450	HHP	0.0036	FP	0.00003	FP	50	FP	0.23	FP
78	Fipronil	92	HHP	0.248	FP	0.19	FP	0.068	FP	0.0042	FP
80	Fluazifop-P-butyl	2451	HHP	1.41	FP	0.62	FP	0.67	FP	200	FP
81	Flumethrin	972	CC	1.36	CC	0.0093	CC	8.47	CC	0.33	CC
82	Fluometuron	4323	CC	2.65	CC	0.26	CC	0.17	CC	88.6	PG
83	fluroxypyr	2000	FP	14.3	FP	100	FP	49.8	FP	100	FP
84	Formaldehyde	550	HHP	1.84	FP	0.43	FP	0.88	FP	62	PG
85	Furfural	65	HHP	3.06	FP	20.4	FP	5.53	PG	62	PG
86	Glyphosate	4230	HHP	38	FP	40	FP	4.4	FP	100	FP
87	Halosulfuron	8866	HHP	51.8	PG	92.4	PG	98	FP	88.6	PG

88	Halosulfuron-methyl	7758	FP	131	FP	107	FP	0.0053	FP	100	FP
89	Hexaconazole	2180	HHP	3.4	FP	2.9	FP	1.7	FP	0.1	FP
90	Hexazinone	1690	HHP	320	FP	85	FP	0.0145	FP	60	FP
91	Hydramethylnon	1200	HHP	0.16	FP	1.14	FP	0.018	FP	30	FP
92	Imazapic	5000	FP	100	FP	100	FP	0.051	FP	100	FP
93	Imazapyr	2000	FP	100	FP	100	FP	71	FP	25	FP
94	Imidacloprid	450	HHP	211	FP	85	FP	10	FP	0.0037	FP
95	Imiprothrin	900	HHP	0.038	FP	0.051	FP	3.1	FP	0.33	CC
96	Indoxacarb	286	HHP	0.65	FP	0.6	FP	0.11	FP	0.094	FP
97	Isoxaflutole	5000	FP	1.7	FP	1.5	FP	0.12	FP	100	FP
98	Lambda-cyhalothrin	56	HHP	0.00021	FP	0.00036	FP	0.3	FP	0.038	FP
99	Linuron	1146	FP	3.15	FP	0.31	FP	0.016	FP	160	FP
100	Lufenuron	2000	FP	29	FP	0.0013	FP	8.8	FP	197	FP
101	Malathion	2100	HHP	0.018	FP	0.0007	FP	13	FP	0.16	FP
102	Mancozeb	5000	FP	0.074	FP	0.073	FP	0.044	FP	141	FP
103	MCPA	700	HHP	50	FP	190	FP	79.8	FP	200	FP
104	Mesotrione	5000	FP	120	FP	900	FP	3.5	FP	11	FP
105	Metalaxyl	670	HHP	100	FP	28	FP	33	FP	200	FP
106	Metalaxyl-M	375	HHP	100	FP	100	FP	36	FP	127	FP
107	Metaldehyde	227	HHP	75	FP	78.4	FP	75.9	FP	87.5	FP
109	Methamidophos	30	HHP	25	FP	0.27	FP	178	FP	0.22	FP
110	Methiocarb	20	HHP	0.65	FP	0.008	FP	2.2	FP	0.23	FP
111	Methomyl	17	HHP	0.63	FP	0.0076	FP	100	FP	0.16	FP
112	Methyl bromide	214	FP	3.9	FP	2.6	FP	3.2	FP	50	FP
113	Methyl isothiazolin one	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
114	Methylchoroisothiazolinone	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
115	Metolachlor	2780	HHP	3.9	FP	23.5	FP	57.1	FP	110	FP
116	Metribuzin	322	HHP	74.6	FP	49	FP	0.02	FP	53	FP
117	Metsulfuron-methyl	5000	FP	150	FP	150	FP	0.045	FP	25	FP
118	Mevinphos	3.5	FP	0.012	FP	0.00016	FP	71	FP	0.027	FP

119	Mineral oil	4323	CC	2.65	CC	0.256	CC	0.17	CC	26.3	PG
120	Molinate	720	HHP	16	FP	14.9	FP	0.5	FP	11	FP
121	Monocrotophos	14	HHP	7	FP	0.023	FP	88.3	CC	0.02	FP
122	Monosodium methyl arsenate	2782	PG	51.8	PG	92.4	PG	14.0	PG	88.6	PG
123	Nonylphenol	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
124	Octylisothiazolinone	631	PG	25.2	PG	21.1	PG	5.53	PG	62	PG
125	Oxadiazon	5000	FP	1.2	FP	2.4	FP	0.004	FP	100	FP
126	Oxamyl	6	HHP	3.13	FP	0.319	FP	0.93	FP	0.38	FP
127	Oxyfluorfen	5000	FP	0.25	FP	0.72	FP	2	FP	100	FP
128	Paraquat	150	HHP	19	FP	4.4	FP	0.00023	FP	9.06	FP
129	pencycuron	5000	FP	0.3	FP	0.3	FP	0.3	FP	98.5	FP
130	Pendimethalin	1050	HHP	0.138	FP	0.28	FP	0.006	FP	100	FP
131	Permethrin	500	FP	0.0125	FP	0.0006	FP	0.0125	FP	0.029	FP
132	phenothrin	5000	FP	0.0027	FP	0.0043	FP	8.5	CC	0.33	CC
133	Phosphoric acid	454	FP	1667	CC	167	CC	73.9	CC	62.1	CC
134	Picloram	8200	HHP	8.8	FP	44.2	FP	60.2	FP	74	FP
135	Pine oil	3579	CC	51.8	PG	57	CC	14.0	PG	50.0	CC
136	Piperonyl butoxide	7220	FP	5.3	FP	0.51	FP	0.24	FP	294	FP
137	Pirimiphos methyl	1667	HHP	0.404	FP	0.00021	FP	1	FP	0.22	FP
138	Prallethrin	460	HHP	0.012	FP	0.0062	FP	8.47	CC	0.026	FP
139	Profenofos	358	HHP	0.08	FP	0.5	FP	88.3	CC	0.095	FP
140	Prometryn	3150	HHP	5.5	FP	12.66	FP	0.002	FP	99	FP
141	Propanil	1400	HHP	5.4	FP	2.39	FP	0.11	FP	94.3	FP
142	Propargite	2639	FP	0.043	FP	0.014	FP	1.08	FP	47.9	FP
143	Propineb	8500	HHP	0.4	FP	4.7	FP	2.68	FP	70	FP
144	Propoxur	50	FP	6.2	FP	0.15	FP	26.1	CC	1.35	FP
145	Pyrethrins	750	HHP	2.65	CC	0.26	CC	0.17	CC	26.3	PG
146	Quinclorac	2680	HHP	100	FP	29.8	FP	6.53	FP	181	FP
147	Quizalofop-P-tefuryl	1012	HHP	0.23	FP	1.51	FP	1.9	FP	100	FP
150	S-Metolachlor	2577	HHP	1.23	FP	26	FP	0.008	FP	85	FP

151	Spinosad	3738	HHP	30	FP	14	FP	0.09	FP	0.0029	FP
152	Sulcotrione	5000	FP	227	FP	848	FP	1.2	FP	50	FP
153	Sulfentrazone	2855	FP	93.8	FP	60.4	FP	32.8	FP	25.1	FP
154	Sulphur	2000	FP	0.063	FP	0.063	FP	0.063	FP	100	FP
155	Tebuconazole	1700	HHP	4.4	FP	2.79	FP	1.96	FP	83.05	FP
156	Tebuthiuron	644	HHP	87	FP	225	FP	0.05	FP	30	FP
157	Terbufos	2	HHP	0.004	FP	0.00031	FP	1.4	FP	4.1	FP
158	terbuthylazine	2160	HHP	2.2	FP	21.2	FP	0.012	FP	22.6	FP
159	Terbutryn	2500	FP	1.1	FP	2.66	FP	0.0024	FP	225	FP
160	Tetradifon	14700	FP	880	FP	2	FP	100	FP	11	FP
161	Tetramethrin	5000	FP	0.016	FP	0.045	FP	8.5	FP	0.16	FP
162	Thiamethoxam	1563	FP	125	FP	100	FP	100	FP	0.005	FP
163	Thiram	1800	FP	0.046	FP	0.011	FP	0.065	FP	100	FP
164	Transfluthrin	5000	FP	0.0007	FP	0.0017	FP	0.1	FP	26.3	PG
165	Triadimefon	300	FP	4.08	FP	7.16	FP	2.01	FP	25	FP
166	Triadimenol	900	HHP	21.3	FP	51	FP	9.6	FP	200	FP
167	Trichlorfon	212	FP	0.7	FP	0.00096	FP	10	FP	0.4	FP
170	Triclopyr	710	HHP	117	FP	131	FP	75.8	FP	100	FP
171	Tricozene	4323	CC	2.65	CC	0.256	CC	0.17	CC	62	PG
172	Trifloxystrobin	5000	FP	0.015	FP	0.011	FP	0.0053	FP	200	FP
173	Trifluralin	5000	FP	0.088	FP	0.245	FP	0.0122	FP	100	FP
174	Trifluthrin	972	CC	1.36	CC	0.0093	CC	8.5	CC	0.33	CC
175	Violeta Genciana	4323	CC	2.65	CC	0.256	CC	0.17	CC	26.3	PG

Annex 2 Human hazard

Tables;

1. Products with major contribution to the acute human hazard
2. Carcinogenic active ingredients
3. Mutagenic active ingredients
4. Active ingredients toxic to reproduction

Table 2.1: Products with major contribution to the acute human hazard: i.e. all Highly hazardous products (WHO class Ib) and the Moderately hazardous products (WHO class II) with a contribution > 1% of the annual volume of all products imported.

Year	Product ID	Product name	(kg)	(%)	WHO class
2002	1904	Phosgard 56% FT	1512	1.61	Ib
2002	1779	Nemacur 40% EC	500	0.53	Ib
2002	1406	Gramoxone 20% SL	8000	8.50	II
2002	2363	Tamaron 58% SL	2500	2.66	II
2002	2622	Villa Politrin 20% EC	2200	2.34	II
2002	818	Copper Oxychloride 85% WP	1500	1.59	II
2002	2535	Universal Metamidofos 58,5% SL	1500	1.59	II
2002	1827	Otrthene 75% SP	1200	1.28	II
2002	2501	Universal Cooper Oxychloride 85% WP	1000	1.06	II
2002	2563	Universal Skoffel 14.5% SL	1000	1.06	II
2002	2595	Villa MCPA 20% EC	1000	1.06	II
2003	1340	Fumaphos 56% FT	7015	1.05	Ib
2003	95	Aldicarb 15% GR	3800	0.57	Ib
2003	2376	Temik 15% GR	3200	0.48	Ib
2003	2866	Volcano Aldicarb 15% GR	2400	0.36	Ib
2003	97	Aluminium Phosphide 57% FT	2214	0.33	Ib
2003	1904	Phosgard 56% FT	2016	0.30	Ib
2003	2536	Universal Mevinfos 15% EC	1000	0.15	Ib
2003	1779	Nemacur 40% EC	750	0.11	Ib
2003	2634	Volamiphos 40% EC	750	0.11	Ib
2003	2537	Universal Monocrotofos 40% SL	500	0.07	Ib
2003	3011	Volcano Ametrin 50% EC	39920	5.96	II
2003	3172	Volcano cipermetrina 20% EC	35500	5.30	II
2003	1516	Karate 5% EC	27360	4.09	II
2003	1377	Gesapax 50% SC	25600	3.82	II
2003	883	Cipercal P 72% SL	25126	3.75	II
2003	1238	Ficam VC 80% WP	25038	3.74	II
2003	1406	Gramoxone 20% SL	21800	3.26	II
2003	98	Ametrin 50% SC	20600	3.08	II
2003	1322	Fortis Ultra 4.75% EC	14980	2.24	II
2003	3722	Volcano Methyl Bromide 100 %GA	10500	1.57	II
2003	1620	MCPA 400 SL	10100	1.51	II
2003	914	Cyperpro 72% EC	10000	1.49	II
2003	3668	Volcano MCPA 40% SL	9560	1.43	II
2003	3716	Volcamo Methamidophos 58.5% SL	9000	1.34	II
2003	2746	Volcano 90 SL	7340	1.10	II
2003	2535	Universal Metamidofos 58,5% SL	7000	1.05	II
2004	1198	Falfume 57% FT	8000	0.61	Ib
2004	1957	Quickphos 56% FD	2880	0.22	Ib
2004	1904	Phosgard 56% FT	1512	0.11	Ib
2004	2878	Volcano Alluminium Phosphide 57% FT	1000	0.08	Ib
2004	2376	Temik 15% GR	600	0.05	Ib
2004	2866	Volcano Aldicarb 15% GR	560	0.04	Ib

2004	1906	Phoskill 40% SC	500	0.04	Ib
2004	1340	Fumaphos 56% FT	346	0.03	Ib
2004	2616	Villa Platoon 31% SL	250	0.02	Ib
2004	3011	Volcano Ametrin 50% EC	118820	9.00	II
2004	3286	Volcano Endosulfan 47.5% SC	71574	5.42	II
2004	1516	Karate 5% EC	41576	3.15	II
2004	3668	Volcano MCPA 40% SL	40180	3.04	II
2004	1406	Gramoxone 20% SL	36000	2.73	II
2004	1327	Fortis Xtra 8.8% EC	31250	2.37	II
2004	1321	Fortis K 5% EC	30750	2.33	II
2004	3716	Volcamo Methamidophos 58.5% SL	30600	2.32	II
2004	4245	Zipper 20% EC	30240	2.29	II
2004	732	Ciclor 72% Ec	28050	2.12	II
2004	1455	Icon 10% WP	23345	1.77	II
2004	1377	Gesapax 50% SC	22400	1.70	II
2004	1238	Ficam VC 80% WP	17500	1.33	II
2004	3131	Volcano Cooper Oxychloride 85% WP	15500	1.17	II
2004	2746	Volcano 90 SL	15424	1.17	II
2005	2866	Volcano Aldicarb 15% GR	11400	0.71	Ib
2005	2878	Volcano Alluminium Phosphide 57% FT	3315	0.21	Ib
2005	2634	Volamiphos 40% EC	2000	0.12	Ib
2005	1340	Fumaphos 56% FT	378	0.02	Ib
2005	1904	Phosgard 56% FT	210	0.01	Ib
2005	4171	Vydate 31% SL	160	0.01	Ib
2005	139	Avi-DDT 75% WP	136000	8.49	II
2005	3011	Volcano Ametrin 50% EC	117000	7.31	II
2005	1455	Icon 10% WP	60698	3.79	II
2005	4080	Volmetra 50% SC	50800	3.17	II
2005	3716	Volcamo Methamidophos 58.5% SL	50120	3.13	II
2005	1327	Fortis Xtra 8.8% EC	43100	2.69	II
2005	1321	Fortis K 5% EC	32820	2.05	II
2005	3287	Volcano Endosulfan 50% EC	24000	1.50	II
2005	1238	Ficam VC 80% WP	20000	1.25	II
2005	3131	Volcano Cooper Oxychloride 85% WP	19500	1.22	II
2005	3172	Volcano cipermetrina 20% EC	18764	1.17	II
2005	883	Cipercal P 72% SL	18000	1.12	II
2006	1198	Falfume 57% FT	6001	0.30	Ib
2006	2878	Volcano Alluminium Phosphide 57% FT	4311	0.21	Ib
2006	2634	Volamiphos 40% EC	1025	0.05	Ib
2006	1904	Phosgard 56% FT	210	0.01	Ib
2006	1340	Fumaphos 56% FT	126	0.01	Ib
2006	1954	Provoke 75% WG	369339	18.19	II
2006	3011	Volcano Ametrin 50% EC	132880	6.54	II
2006	1321	Fortis K 5% EC	68060	3.35	II
2006	4241	Zakanaka Top 10% EC	53910	2.66	II
2006	4198	Zakanaka K 6% EC	52440	2.58	II
2006	4080	Volmetra 50% SC	41080	2.02	II
2006	1238	Ficam VC 80% WP	36200	1.78	II
2006	3668	Volcano MCPA 40% SL	31810	1.57	II
2006	3172	Volcano cipermetrina 20% EC	24500	1.21	II
2006	4219	Zakaka Pro 64,8% EC	24290	1.20	II
2006	3716	Volcamo Methamidophos 58.5% SL	23220	1.14	II
2006	3131	Volcano Cooper Oxychloride 85% WP	22750	1.12	II
2006	4134	Volquato 20% SL	20900	1.03	II
2007	1198	Falfume 57% FT	8800	0.69	Ib
2007	2878	Volcano Alluminium Phosphide 57% FT	6021	0.47	Ib
2007	2634	Volamiphos 40% EC	1500	0.12	Ib
2007	1906	Phoskill 40% SC	1200	0.09	Ib
2007	1957	Quickphos 56% FD	599	0.05	Ib
2007	1904	Phosgard 56% FT	210	0.02	Ib
2007	4171	Vydate 31% SL	120	0.01	Ib
2007	1340	Fumaphos 56% FT	42	0.00	Ib
2007	3011	Volcano Ametrin 50% EC	92140	7.21	II

2007	3668	Volcano MCPA 40% SL	54760	4.29	II
2007	3716	Volcamo Methamidophos 58.5% SL	42800	3.35	II
2007	4198	Zakanaka K 6% EC	38000	2.97	II
2007	4219	Zakaka Pro 64,8% EC	35000	2.74	II
2007	1238	Ficam VC 80% WP	32719	2.56	II
2007	1575	Lambda cyhalothrin 5% EC	30090	2.35	II
2007	882	Cyper pro 72% EC	29200	2.29	II
2007	4241	Zakanaka Top 10% EC	27880	2.18	II
2007	4134	Volquato 20% SL	21360	1.67	II
2007	3287	Volcano Endosulfan 50% EC	21000	1.64	II
2007	1321	Fortis K 5% EC	17750	1.39	II
2007	830	Courage 70% WS	17000	1.33	II
2007	4080	Volmetra 50% SC	14840	1.16	II
2007	3131	Volcano Cooper Oxychloride 85% WP	13923	1.09	II
2008	2066	Rotam Terbufos 15% GR	31000	1.53	Ib
2008	1904	Phosgard 56% FT	2079	0.10	Ib
2008	4171	Vydate 31% SL	300	0.01	Ib
2008	1954	Provoke 75% WG	513300	25.28	II
2008	1321	Fortis K 5% EC	98970	4.87	II
2008	3668	Volcano MCPA 40% SL	71100	3.50	II
2008	3011	Volcano Ametrin 50% EC	62800	3.09	II
2008	4198	Zakanaka K 6% EC	60500	2.98	II
2008	4219	Zakaka Pro 64,8% EC	45000	2.22	II
2008	3131	Volcano Cooper Oxychloride 85% WP	33010	1.63	II
2008	2746	Volcano 90 SL	27900	1.37	II
2008	4241	Zakanaka Top 10% EC	26500	1.31	II
2008	1406	Gramoxone 20% SL	21000	1.03	II
2008	3172	Volcano cipermetrina 20% EC	20500	1.01	II
2009	662	Bongo	45000	1.94	Ib
2009	2878	Volcano Alluminium Phosphide 57% FT	6510	0.28	Ib
2009	1553	Kuik	1000	0.04	Ib
2009	4171	Vydate 31% SL	480	0.02	Ib
2009	1904	Phosgard 56% FT	462	0.02	Ib
2009	3011	Volcano Ametrin 50% EC	161140	6.96	II
2009	2020	Revival 10% WP	120333	5.20	II
2009	3668	Volcano MCPA 40% SL	60360	2.61	II
2009	3131	Volcano Cooper Oxychloride 85% WP	54660	2.36	II
2009	1321	Fortis K 5% EC	42750	1.85	II
2009	4134	Volquato 20% SL	42240	1.82	II
2009	4198	Zakanaka K 6% EC	32760	1.41	II
2009	3180	Volcano D 2,4 72% SL	32000	1.38	II
2009	3716	Volcamo Methamidophos 58.5% SL	28830	1.24	II
2009	2677	Volcano 2,4 D 72% SL	28000	1.21	II
2009	4241	Zakanaka Top 10% EC	27230	1.18	II
2009	1238	Ficam VC 80% WP	26054	1.12	II
2010	2878	Volcano Alluminium Phosphide 57% FT	15519	0.58	Ib
2010	1198	Falfume 57% FT	13800	0.52	Ib
2010	1752	Moz Abamec Plus 18% EC	800	0.03	Ib
2010	1904	Phosgard 56% FT	525	0.02	Ib
2010	4171	Vydate 31% SL	500	0.02	Ib
2010	2020	Revival 10% WP	214300	8.00	II
2010	3011	Volcano Ametrin 50% EC	136060	5.08	II
2010	4241	Zakanaka Top 10% EC	63980	2.39	II
2010	3668	Volcano MCPA 40% SL	53440	2.00	II
2010	3131	Volcano Cooper Oxychloride 85% WP	52130	1.95	II
2010	2677	Volcano 2,4 D 72% SL	47000	1.76	II
2010	4219	Zakaka Pro 64,8% EC	42100	1.57	II
2010	4062	Volmet 58,5% SL	34760	1.30	II
2010	3172	Volcano cipermetrina 20% EC	32760	1.22	II
2010	1321	Fortis K 5% EC	30060	1.12	II
2011	2878	Volcano Alluminium Phosphide 57% FT	11970	0.46	Ib
2011	1904	Phosgard 56% FT	1470	0.06	Ib
2011	1756	Moz Aluminium Phosphide 56% FT	1250	0.05	Ib

2011	4171	Vydate 31% SL	300	0.01	Ib
2011	1752	Moz Abamec Plus 18% EC	240	0.01	Ib
2011	3011	Volcano Ametrin 50% EC	134900	5.20	II
2011	1203	Fendona 5% WP	75600	2.92	II
2011	3030	Volcano Copper Oxychloride 85% WP	70700	2.73	II
2011	4219	Zakaka Pro 64,8% EC	65500	2.53	II
2011	4241	Zakanaka Top 10% EC	60500	2.33	II
2011	3668	Volcano MCPA 40% SL	60200	2.32	II
2011	4198	Zakanaka K 6% EC	55300	2.13	II
2011	4134	Volquato 20% SL	35100	1.35	II
2011	1321	Fortis K 5% EC	35000	1.35	II
2011	2677	Volcano 2,4 D 72% SL	32600	1.26	II
2011	3172	Volcano cipermetrina 20% EC	30450	1.17	II

Table 2.2: Carcinogenic active ingredients with the contribution to the annual volume of active ingredients imported (in %).

Year	Compound ID	Compound name	(kg)	(%)
2002	102	Mancozeb	2000	10.7
2002	57	Dichlorvos	461	2.46
2002	131	Permethrin	24	0.13
2003	64	Diuron	20400	6.53
2003	102	Mancozeb	15248	4.88
2003	57	Dichlorvos	1641	0.53
2003	37	Chlorothalonil	400	0.13
2003	8	Alachlor	384	0.12
2003	131	Permethrin	18	0.01
2004	102	Mancozeb	44848	7.72
2004	64	Diuron	44672	7.69
2004	57	Dichlorvos	6162	1.06
2004	37	Chlorothalonil	1537	0.26
2004	8	Alachlor	384	0.07
2004	131	Permethrin	28	0.005
2005	64	Diuron	40976	5.90
2005	102	Mancozeb	20080	2.89
2005	57	Dichlorvos	1513	0.22
2005	37	Chlorothalonil	1382	0.20
2005	131	Permethrin	40	0.01
2006	64	Diuron	40312	4.49
2006	102	Mancozeb	23666	2.63
2006	57	Dichlorvos	5323	0.59
2006	8	Alachlor	1260	0.14
2006	37	Chlorothalonil	691	0.08
2006	131	Permethrin	28	0.003
2007	64	Diuron	33568	6.05
2007	102	Mancozeb	30936	5.57
2007	64	Diuron	23072	4.16
2007	102	Mancozeb	15782	2.84
2007	57	Dichlorvos	6376	1.15
2007	57	Dichlorvos	3551	0.64
2007	8	Alachlor	1800	0.32
2007	125	Oxadiazon	950	0.17
2007	37	Chlorothalonil	850	0.15
2007	131	Permethrin	246	0.04
2007	131	Permethrin	34	0.01
2007	30	Carbaryl	20	0.004
2009	64	Diuron	48899	5.69
2009	102	Mancozeb	30003	3.49
2009	125	Oxadiazon	5000	0.58
2009	57	Dichlorvos	2433	0.28
2009	37	Chlorothalonil	1000	0.12
2009	97	Isoxaflutole	750	0.09
2009	131	Permethrin	49	0.01
2009	84	Formaldehyde	13	0.00
2010	102	Mancozeb	53574	5.58
2010	64	Diuron	37889	3.95
2010	37	Chlorothalonil	5500	0.57
2010	57	Dichlorvos	2921	0.30
2010	97	Isoxaflutole	1920	0.20
2010	127	Oxyfluorfen	216	0.02
2010	131	Permethrin	114	0.01
2010	84	Formaldehyde	50	0.01
2010	30	Carbaryl	8	0.001
2011	102	Mancozeb	61075	6.48

2011	64	Diuron	43312	4.60
2011	57	Dichlorvos	5421	0.58
2011	84	Formaldehyde	1074	0.11
2011	37	Chlorothalonil	750	0.08
2011	131	Permethrin	84	0.01
2011	30	Carbaryl	84	0.01
2011	97	Isoxaflutole	15	0.002

Table 2.3: Mutagenic active ingredients with the contribution to the annual volume of active ingredients imported (in %).

Year	Compound ID	Compound name	(kg)	(%)
2004	20	Benomyl	735	0.13
2005	20	Benomyl	200	0.029
2006	20	Benomyl	200	0.022
2007	31	Carbendazim	1.3	0.0002
2008	31	Carbendazim	5	0.001
2009	20	Benomyl	500	0.058
2009	31	Carbendazim	54	0.006
2010	20	Benomyl	2800	0.29
2010	31	Carbendazim	0.4	0.00004
2011	31	Carbendazim	0.6	0.0001

Table 2.4: Active ingredients toxic to reproduction with the contribution to the annual volume of active ingredients imported (in %).

Year	Compound ID	Compound name	(kg)	(%)
2004	20	Benomyl	735	0.13
2005	20	Benomyl	200	0.029
2006	20	Benomyl	200	0.022
2007	31	Carbendazim	1.3	0.0002
2008	31	Carbendazim	5	0.001
2009	20	Benomyl	500	0.058
2009	31	Carbendazim	54	0.006
2010	20	Benomyl	2800	0.29
2010	31	Carbendazim	0.4	0.00004
2011	31	Carbendazim	0.6	0.0001

Annex 3 Environmental toxic Loads

Tables;

1. Active ingredients with the major contribution to the annual ETL for fish
2. Active ingredients with the major contribution to the annual ETL for Daphnia
3. Active ingredients with the major contribution to the annual ETL for algae
4. Active ingredients with the major contribution to the annual ETL for bees

Table 3.1: Active ingredients with the major contribution to the annual ETL for fish (i.e. > 0.5 %).

Year	RankNr	Compound Nr.	Compound name	(kg)	(%)
2002	1	38	Chlorpyrifos	240	30.1
2002	2	49	Cypermethrin	440	25.6
2002	3	11	Aluminium phosphide	847	14.2
2002	4	47	Cyfluthrin	37	12.7
2002	5	65	Endosulfan	70	5.7
2002	6	102	Mancozeb	2000	4.4
2002	7	72	Fenamiphos	200	3.5
2002	8	154	Sulphur	800	2.1
2002	9	142	Propargite	240	0.9
2003	1	98	Lambda-cyhalothrin	2158	56.8
2003	2	49	Cypermethrin	12317	24.3
2003	3	38	Chlorpyrifos	1699	7.2
2003	4	11	Aluminium phosphide	6319	3.6
2003	5	23	Beta-cyfluthrin	30	2.4
2003	6	139	Profenofos	22226	1.5
2003	7	102	Mancozeb	15248	1.1
2004	1	98	Lambda-cyhalothrin	7992	50.1
2004	2	65	Endosulfan	34103	22.4
2004	3	38	Chlorpyrifos	18078	18.3
2004	4	49	Cypermethrin	12034	5.7
2004	5	11	Aluminium phosphide	7783	1.1
2004	6	102	Mancozeb	44848	0.8
2004	7	23	Beta-cyfluthrin	40	0.8
2005	1	98	Lambda-cyhalothrin	12377	80.8
2005	2	65	Endosulfan	12140	8.3
2005	3	49	Cypermethrin	6813	3.3
2005	4	23	Beta-cyfluthrin	111	2.2
2005	5	38	Chlorpyrifos	1200	1.3
2005	6	77	Fenvalerate	3050	1.2
2005	7	73	Fenbutatin oxide	550	0.7
2006	1	98	Lambda-cyhalothrin	11698	84.4
2006	2	65	Endosulfan	7885	6.0
2006	3	49	Cypermethrin	7857	4.3
2006	4	38	Chlorpyrifos	1536	1.8
2006	5	11	Aluminium phosphide	6066	0.9
2006	6	139	Profenofos	27471	0.5
2006	7	23	Beta-cyfluthrin	23	0.5
2007	1	98	Lambda-cyhalothrin	8216	67.2
2007	2	65	Endosulfan	10588	9.1
2007	3	55	Deltamethrin	1204	7.9
2007	4	38	Chlorpyrifos	3056	4.0
2007	5	49	Cypermethrin	6174	3.8
2007	6	77	Fenvalerate	5439	2.6
2007	7	11	Aluminium phosphide	8925	1.6
2007	8	73	Fenbutatin oxide	605	0.9

2007	9	139	Profenofos	39720	0.9
2007	10	102	Mancozeb	30936	0.7
2007	11	23	Beta-cyfluthrin	23	0.6
2008	1	98	Lambda-cyhalothrin	13263	81.4
2008	2	55	Deltamethrin	1579	7.8
2008	3	38	Chlorpyrifos	3223	3.2
2008	4	49	Cypermethrin	5450	2.5
2008	5	157	Terbufos	4650	1.5
2008	6	65	Endosulfan	1050	0.7
2009	1	98	Lambda-cyhalothrin	20403	89.4
2009	2	38	Chlorpyrifos	4366	3.1
2009	3	157	Terbufos	6750	1.6
2009	4	49	Cypermethrin	4139	1.4
2009	5	77	Fenvalerate	4000	1.0
2009	6	73	Fenbutatin oxide	1164	0.9
2009	7	55	Deltamethrin	189	0.7
2010	1	98	Lambda-cyhalothrin	30610	89.4
2010	2	38	Chlorpyrifos	11772	5.6
2010	3	49	Cypermethrin	8335	1.8
2010	4	11	Aluminium phosphide	17006	1.1
2011	1	98	Lambda-cyhalothrin	12760	83.4
2011	2	38	Chlorpyrifos	4279	4.5
2011	3	49	Cypermethrin	6926	3.4
2011	4	10	Alpha-cypermethrin	3780	1.9
2011	5	65	Endosulfan	2548	1.7
2011	6	11	Aluminium phosphide	8346	1.2
2011	7	102	Mancozeb	61075	1.1
2011	8	139	Profenofos	55130	0.9
2011	9	55	Deltamethrin	145	0.8

Table 3.2: Active ingredients with the major contribution to the annual ETL for Daphnia (i.e. > 0.5 %).

Year	RankNr	Compound Nr.	Compound name	(kg)	(%)
2002	1	57	Dichlorvos	461	32.2
2002	2	38	Chlorpyrifos	240	31.8
2002	3	49	Cypermethrin	440	19.5
2002	4	137	Pirimiphos methyl	96	6.1
2002	5	39	Chlorpyrifos-methyl	200	4.4
2002	6	47	Cyfluthrin	37	3.0
2002	7	72	Fenamiphos	200	1.4
2002	8	131	Permethrin	24	0.5
2003	1	49	Cypermethrin	12317	43.9
2003	2	38	Chlorpyrifos	1699	18.2
2003	3	137	Pirimiphos methyl	3069	15.6
2003	4	57	Dichlorvos	1641	9.2
2003	5	98	Lambda-cyhalothrin	2158	6.4
2003	6	77	Fenvalerate	76	2.7
2003	7	118	Mevinphos	150	1.0
2003	8	19	Bendiocarb	20030	0.7
2003	9	33	Carbosulfan	835	0.6
2004	1	38	Chlorpyrifos	18078	60.4
2004	2	49	Cypermethrin	12034	13.4
2004	3	57	Dichlorvos	6162	10.8
2004	4	98	Lambda-cyhalothrin	7992	7.4
2004	5	137	Pirimiphos methyl	4094	6.5
2005	1	77	Fenvalerate	3050	38.6
2005	2	68	Ethion	2525	17.1
2005	3	98	Lambda-cyhalothrin	12377	13.1
2005	4	49	Cypermethrin	6813	8.6
2005	5	53	DDT	102000	7.7
2005	6	137	Pirimiphos methyl	2876	5.2
2005	7	38	Chlorpyrifos	1200	4.6
2005	8	57	Dichlorvos	1513	3.0
2005	9	35	Chlorfenvinphos	600	0.9
2006	1	53	DDT	285929	26.5
2006	2	68	Ethion	2525	20.9
2006	3	98	Lambda-cyhalothrin	11698	15.1
2006	4	57	Dichlorvos	5323	13.0
2006	5	49	Cypermethrin	7857	12.1
2006	6	38	Chlorpyrifos	1536	7.1
2006	7	77	Fenvalerate	100	1.5
2006	8	137	Pirimiphos methyl	538	1.2
2006	9	35	Chlorfenvinphos	636	1.2
2007	1	77	Fenvalerate	5439	51.5
2007	2	68	Ethion	3030	15.4
2007	3	57	Dichlorvos	6376	9.5
2007	4	38	Chlorpyrifos	3056	8.7
2007	5	98	Lambda-cyhalothrin	8216	6.5
2007	6	49	Cypermethrin	6174	5.8
2007	7	137	Pirimiphos methyl	857	1.2
2007	8	55	Deltamethrin	1204	0.6
2008	1	53	DDT	384975	31.4
2008	2	98	Lambda-cyhalothrin	13263	15.0
2008	3	38	Chlorpyrifos	3223	13.2
2008	4	77	Fenvalerate	800	10.9
2008	5	57	Dichlorvos	3551	7.6
2008	6	49	Cypermethrin	5450	7.4
2008	7	157	Terbufos	4650	6.1
2008	8	137	Pirimiphos methyl	2490	4.8
2008	9	55	Deltamethrin	1579	1.2

2008	10	35	Chlorfenvinphos	375	0.6
2009	1	77	Fenvalerate	4000	45.5
2009	2	98	Lambda-cyhalothrin	20403	19.4
2009	3	38	Chlorpyrifos	4366	14.9
2009	4	157	Terbufos	6750	7.4
2009	5	49	Cypermethrin	4139	4.7
2009	6	57	Dichlorvos	2433	4.4
2009	7	137	Pirimiphos methyl	1010	1.6
2010	1	38	Chlorpyrifos	11772	42.5
2010	2	98	Lambda-cyhalothrin	30610	30.7
2010	3	49	Cypermethrin	8335	10.0
2010	4	77	Fenvalerate	500	6.0
2010	5	57	Dichlorvos	2921	5.5
2010	6	137	Pirimiphos methyl	1966	3.4
2010	7	3	Abamectin	189	0.7
2011	1	38	Chlorpyrifos	4279	27.9
2011	2	98	Lambda-cyhalothrin	12760	23.1
2011	3	57	Dichlorvos	5421	18.6
2011	4	49	Cypermethrin	6926	15.1
2011	5	10	Alpha-cypermethrin	3780	8.2
2011	6	137	Pirimiphos methyl	1394	4.3
2011	7	3	Abamectin	115	0.8
2011	8	102	Mancozeb	61075	0.5

Table 3.3: Active ingredients with the major contribution to the annual ETL for algae (i.e. > 0.5 %).

Year	RankNr	Compound Nr.	Compound name	(kg)	(%)
2002	1	128	Paraquat	1745	98.5
2002	2	102	Mancozeb	2000	0.6
2003	1	7	Acetochlor	14652	56.5
2003	2	128	Paraquat	4721	21.4
2003	3	12	Ametryn	43060	12.5
2003	4	64	Diuron	20400	7.9
2004	1	7	Acetochlor	33768	63.0
2004	2	128	Paraquat	7418	16.3
2004	3	12	Ametryn	70610	9.9
2004	4	64	Diuron	44672	8.3
2004	5	159	Terbutryn	6203	1.3
2004	6	102	Mancozeb	44848	0.5
2005	1	7	Acetochlor	59061	76.0
2005	2	128	Paraquat	5377	8.1
2005	3	12	Ametryn	82480	8.0
2005	4	64	Diuron	40976	5.3
2005	5	140	Prometryn	5280	0.9
2005	6	130	Pendimethalin	15170	0.9
2006	1	7	Acetochlor	41454	68.7
2006	2	128	Paraquat	6604	12.8
2006	3	12	Ametryn	76710	9.5
2006	4	64	Diuron	40312	6.7
2006	5	130	Pendimethalin	14220	1.1
2007	1	7	Acetochlor	30591	71.3
2007	2	128	Paraquat	4272	11.7
2007	3	12	Ametryn	51060	8.9
2007	4	64	Diuron	23072	5.4
2007	5	130	Pendimethalin	11240	1.2
2008	1	7	Acetochlor	72239	84.3
2008	2	128	Paraquat	4600	6.3
2008	3	64	Diuron	33568	3.9
2008	4	12	Ametryn	41040	3.6
2008	5	130	Pendimethalin	26130	1.4
2009	1	7	Acetochlor	66996	74.5
2009	2	128	Paraquat	8448	11.0
2009	3	12	Ametryn	80570	6.7
2009	4	64	Diuron	48899	5.4
2009	5	130	Pendimethalin	20090	1.0
2010	1	7	Acetochlor	80856	81.8
2010	2	128	Paraquat	4540	5.4
2010	3	12	Ametryn	68030	5.2
2010	4	64	Diuron	37889	3.8
2010	5	130	Pendimethalin	61120	2.8
2011	1	7	Acetochlor	57456	74.6
2011	2	128	Paraquat	7020	10.7
2011	3	12	Ametryn	67450	6.6
2011	4	64	Diuron	43312	5.6
2011	5	130	Pendimethalin	27180	1.6

Table 3.4: Active ingredients with the major contribution to the annual ETL for bees (i.e. > 0.5 %)

Year	RankNr	Compound Nr.	Compound name	(kg)	(%)
2002	1	94	Imidacloprid	269	46.0
2002	2	47	Cyfluthrin	37	23.3
2002	3	49	Cypermethrin	440	13.9
2002	4	109	Methamidophos	2340	6.7
2002	5	38	Chlorpyrifos	240	2.6
2002	6	11	Aluminium phosphide	847	2.2
2002	7	39	Chlorpyrifos-methyl	200	1.2
2002	8	57	Dichlorvos	461	1.0
2002	9	32	Carbofuran	50	0.9
2002	10	131	Permethrin	24	0.5
2003	1	49	Cypermethrin	12317	41.6
2003	2	139	Profenofos	22226	15.8
2003	3	19	Bendiocarb	20030	13.5
2003	4	162	Thiamethoxam	521	7.0
2003	5	109	Methamidophos	12578	3.9
2003	6	98	Lambda-cyhalothrin	2158	3.8
2003	7	47	Cyfluthrin	41	2.8
2003	8	23	Beta-cyfluthrin	30	2.0
2003	9	38	Chlorpyrifos	1699	1.9
2003	10	11	Aluminium phosphide	6319	1.8
2003	11	9	Aldicarb	1410	1.1
2003	12	137	Pirimiphos methyl	3069	0.9
2003	13	3	Abamectin	23	0.7
2003	14	121	Monocrotophos	200	0.7
2004	1	49	Cypermethrin	12034	29.4
2004	2	38	Chlorpyrifos	18078	15.0
2004	3	162	Thiamethoxam	1488	14.5
2004	4	98	Lambda-cyhalothrin	7992	10.3
2004	5	19	Bendiocarb	14000	6.8
2004	6	94	Imidacloprid	332	4.4
2004	7	109	Methamidophos	19656	4.4
2004	8	139	Profenofos	5150	2.6
2004	9	47	Cyfluthrin	54	2.6
2004	10	23	Beta-cyfluthrin	40	2.0
2004	11	11	Aluminium phosphide	7783	1.6
2004	12	3	Abamectin	58	1.3
2004	13	57	Dichlorvos	6162	1.0
2004	14	137	Pirimiphos methyl	4094	0.9
2004	15	63	Dimethoate	1440	0.6
2004	16	89	Hexaconazole	1147	0.6
2005	1	94	Imidacloprid	2161	25.0
2005	2	49	Cypermethrin	6813	14.6
2005	3	98	Lambda-cyhalothrin	12377	13.9
2005	4	139	Profenofos	19977	9.0
2005	5	162	Thiamethoxam	910	7.8
2005	6	19	Bendiocarb	16000	6.8
2005	7	109	Methamidophos	35024	6.8
2005	8	23	Beta-cyfluthrin	111	4.8
2005	9	47	Cyfluthrin	90	3.9
2005	10	78	Fipronil	120	1.2
2005	11	53	DDT	102000	0.9
2005	12	38	Chlorpyrifos	1200	0.9
2005	13	9	Aldicarb	1710	0.8
2005	14	89	Hexaconazole	1733	0.7

2005	15	77	Fenvalerate	3050	0.6
2005	16	137	Pirimiphos methyl	2876	0.6
2006	1	94	Imidacloprid	12367	66.9
2006	2	49	Cypermethrin	7857	7.9
2006	3	98	Lambda-cyhalothrin	11698	6.2
2006	4	19	Bendiocarb	28960	5.8
2006	5	139	Profenofos	27471	5.8
2006	6	109	Methamidophos	14110	1.3
2006	7	53	DDT	285929	1.1
2006	8	47	Cyfluthrin	46	0.9
2006	9	89	Hexaconazole	3464	0.7
2006	10	78	Fipronil	120	0.6
2006	11	38	Chlorpyrifos	1536	0.5
2006	12	11	Aluminium phosphide	6066	0.5
2007	1	94	Imidacloprid	12924	59.1
2007	2	55	Deltamethrin	1204	13.6
2007	3	139	Profenofos	39720	7.1
2007	4	49	Cypermethrin	6174	5.2
2007	5	19	Bendiocarb	26175	4.4
2007	6	98	Lambda-cyhalothrin	8216	3.7
2007	7	109	Methamidophos	33521	2.6
2007	8	38	Chlorpyrifos	3056	0.9
2007	9	11	Aluminium phosphide	8925	0.6
2008	1	94	Imidacloprid	14802	61.3
2008	2	55	Deltamethrin	1579	16.1
2008	3	98	Lambda-cyhalothrin	13263	5.3
2008	4	139	Profenofos	29802	4.8
2008	5	49	Cypermethrin	5450	4.2
2008	6	19	Bendiocarb	10816	1.7
2008	7	53	DDT	384975	1.2
2008	8	109	Methamidophos	12969	0.9
2008	9	38	Chlorpyrifos	3223	0.8
2008	10	47	Cyfluthrin	47	0.7
2008	11	3	Abamectin	79	0.6
2009	1	94	Imidacloprid	5955	44.1
2009	2	98	Lambda-cyhalothrin	20403	14.7
2009	3	19	Bendiocarb	21243	5.8
2009	4	49	Cypermethrin	4139	5.7
2009	5	78	Fipronil	840	5.5
2009	6	47	Cyfluthrin	188	5.2
2009	7	139	Profenofos	14256	4.1
2009	8	55	Deltamethrin	189	3.4
2009	9	109	Methamidophos	23886	3.0
2009	10	162	Thiamethoxam	465	2.5
2009	11	38	Chlorpyrifos	4366	2.0
2009	12	3	Abamectin	82	1.0
2010	1	94	Imidacloprid	3781	26.2
2010	2	98	Lambda-cyhalothrin	30610	20.6
2010	3	49	Cypermethrin	8335	10.7
2010	4	78	Fipronil	1586	9.7
2010	5	139	Profenofos	27170	7.3
2010	6	38	Chlorpyrifos	11772	5.1
2010	7	162	Thiamethoxam	950	4.9
2010	8	47	Cyfluthrin	166	4.3
2010	9	109	Methamidophos	20335	2.4
2010	10	3	Abamectin	189	2.2
2010	11	55	Deltamethrin	120	2.1
2010	12	11	Aluminium phosphide	17006	1.8
2010	13	19	Bendiocarb	4648	1.2
2011	1	94	Imidacloprid	3553	29.1
2011	2	139	Profenofos	55130	17.6
2011	3	162	Thiamethoxam	1917	11.6
2011	4	49	Cypermethrin	6926	10.5

2011	5	98	Lambda-cyhalothrin	12760	10.2
2011	6	19	Bendiocarb	11648	3.5
2011	7	10	Alpha-cypermethrin	3780	3.5
2011	8	47	Cyfluthrin	101	3.1
2011	9	55	Deltamethrin	145	2.9
2011	10	38	Chlorpyrifos	4279	2.2
2011	11	3	Abamectin	115	1.6
2011	12	11	Aluminium phosphide	8346	1.1
2011	13	109	Methamidophos	7634	1.1
2011	14	57	Dichlorvos	5421	0.6
2011	15	151	Spinosad	52	0.5

Annex 4: Groundwater leaching

Tables;

1. GUS and groundwater leaching potential class of the active ingredients
2. Active ingredients with the Very high and High groundwater leaching potential class.

Table 4.1: The GUS and groundwater leaching potential class of the active ingredients in the imported products.

Nr.	Compound Name	GUS	Class
1	2,4-D	2.5	3
2	2,4-D dimethylamine	3.0	3
3	Abamectin	-0.2	1
4	Acephate	0.73	1
5	Acetamiprid	0.81	1
6	Acetic acid + ammonia	-0.3	1
7	Acetochlor	2.1	3
8	Alachlor	1.7	2
9	Aldicarb	1.7	2
10	Alpha-cypermethrin	-1.2	1
11	Aluminium phosphide	-2.8	1
12	Ametryn	2.4	3
13	Amicarbazone	3.3	4
14	Amitraz	-5	1
15	Atrazine	3.5	4
16	Azoxystrobin	2.4	3
18	Bacillus thuringiensis	-1.3	1
19	Bendiocarb	0.85	1
20	Benomyl	-3.6	1
21	Bensulfuron-methyl	2.0	2
22	Bentazone	3.5	4
23	Beta-cyfluthrin	-0.9	1
24	Brodifacoum	-1.5	1
25	Bromacil	4.4	5
26	Bromoxynil octanoate	0	1
27	Bupirimate	2.4	3
28	Butralin	-0.9	1
29	Captan	0	1
30	Carbaryl	1.8	2
31	Carbendazim	2.6	3
32	Carbofuran	3.3	4
33	Carbosulfan	0.030	1
34	Carboxin	-10.0	1
35	Chlorfenvinphos	2.1	3
36	Chlorimuron	2.4	3
37	Chlorothalonil	1.2	2
38	Chlorpyrifos	0.15	1
39	Chlorpyrifos-methyl	0.64	1

40	Citronella oil	-5.7	1
41	Clomazone	3.1	4
42	Copper ammonium acetate	2.1	3
43	Copper hydroxide	-0.3	1
44	Copper oxide	2.3	3
45	Copper oxychloride	2.3	3
46	Cycloxydim	0	1
47	Cyfluthrin	0.33	1
48	cymoxanil	0	1
49	Cypermethrin	-2.1	1
50	Cyromazine	1.7	2
51	D-allethrin	1.5	2
52	Dazomet	-15	1
53	DDT	-4.5	1
54	Decanol	-5.7	1
55	Deltamethrin	-4.4	1
56	Diazinon	2.1	3
57	Dichlorvos	0.69	1
58	Didecyldimethylammonium chloride	-6.9	1
59	Diethyltoluamide	3.3	4
60	Difenoconazole	0.87	1
61	Difethialone	-10.5	1
62	Diflubenzuron	0	1
63	Dimethoate	2.3	3
64	Diuron	2.1	3
65	Endosulfan	-0.1	1
66	Epoxiconazole	1.9	2
67	Ethephon	0.72	1
68	Ethion	0	1
69	Ethylbutylacetylaminopropionate	-5.7	1
70	Ethylene dibromide	-5.7	1
71	Ethylene oxide	-5.7	1
72	Fenamiphos	0	1
73	Fenbutatin oxide	-2.5	1
74	Fenitrothion	0.92	1
75	Fenpropathrin	0.44	1
76	Fenthion	1.3	2
77	Fenvalerate	0.43	1
78	Fipronil	2.7	3
80	Fluazifop-P-butyl	0.22	1
81	Flumethrin	-2.4	1
82	Fluometuron	-0.3	1
83	fluroxypyr	-0.8	1
84	Formaldehyde	1.9	2
85	Furfural	0	1
86	Glyphosate	1.0	2
87	Halosulfuron	-0.4	1
88	Halosulfuron-methyl	2.2	3
89	Hexaconazole	2.3	3
90	Hexazinone	4.6	5
91	Hydramethylnon	-1.6	1

92	Imazapic	3.9	4
93	Imazapyr	2.0	2
94	Imidacloprid	3.8	4
95	Imiprothrin	0.98	1
96	Indoxacarb	0.23	1
97	Isoxaflutole	0.55	1
98	Lambda-cyhalothrin	-1.7	1
99	Linuron	1.9	2
100	Lufenuron	-0.7	1
101	Malathion	0	1
102	Mancozeb	1.3	2
103	MCPA	2.9	3
104	Mesotrione	2.3	3
105	Metalaxyl	3.3	4
106	Metalaxyl-M	2.8	3
107	Metaldehyde	1.5	2
109	Methamidophos	1.2	2
110	Methiocarb	1.8	2
111	Methomyl	3.2	4
112	Methyl bromide	4.6	5
113	Methyl isothiazolin one	-5.7	1
114	Methylchoroisothiazolinone	-5.7	1
115	Metolachlor	2.9	3
116	Metribuzin	2.6	3
117	Metsulfuron-methyl	2.4	3
118	Mevinphos	-11.8	1
119	Mineral oil	-2.2	1
120	Molinate	1.9	2
121	Monocrotophos	2.3	3
122	Monosodium methyl arsenate	-0.3	1
123	Nonylphenol	-5.7	1
124	Octylisothiazolinone	-5.7	1
125	Oxadiazon	1.3	2
126	Oxamyl	3.0	4
127	Oxyfluorfen	-0.4	1
128	Paraquat	-6.9	1
129	pencycuron	0.31	1
130	Pendimethalin	-0.5	1
131	Permethrin	-1.6	1
132	phenothrin	0	1
133	Phosphoric acid	2.1	3
134	Picloram	5.5	5
135	Pine oil	-0.2	1
136	Piperonyl butoxide	-1.1	1
137	Pirimiphos methyl	1.3	2
138	Prallethrin	-2.4	1
139	Profenofos	0.59	1
140	Prometryn	2.5	3
141	Propanil	-9.1	1
142	Propargite	-1.3	1
143	Propineb	1.3	2

144	Propoxur	3.9	4
145	Pyrethrins	-2.2	1
146	Quinclorac	6.1	5
147	Quizalofop-P-tefuryl	-6.6	1
150	S-Metolachlor	0.84	1
151	Spinosad	-0.8	1
152	Sulcotrione	2.6	3
153	Sulfentrazone	6.5	5
154	Sulphur	1.0	2
155	Tebuconazole	1.6	2
156	Tebuthiuron	6.5	5
157	Terbufos	1.4	2
158	terbuthylazine	3.4	4
159	Terbutryn	1.0	2
160	Tetradifon	4.1	5
161	Tetramethrin	0.40	1
162	Thiamethoxam	3.9	4
163	Thiram	0.91	1
164	Transfluthrin	-2.2	1
165	Triadimefon	2.2	3
166	Triadimenol	2.5	3
167	Trichlorfon	0	1
170	Triclopyr	4.0	4
171	Tricozene	-5.7	1
172	Trifloxystrobin	0	1
173	Trifluralin	-0.4	1
174	Trifluthrin	-2.4	1
175	Violeta Genciana	-2.2	1

Table 4.2: Active ingredients in the Very high (5) and High (4) groundwater leaching potential class with a contribution to the annual volume of Active ingredients imported > 0.01 %.

Year	Compound number	Compound name	Class number	Volume (kg ai)	(%)
2002	144	Propoxur	4	461	2.46
	94	Imidacloprid		269	1.44
	32	Carbofuran		50	0.27
2003	112	Methyl bromide	5	10290	3.29
	156	Tebuthiuron		2840	0.91
	25	Bromacil		1000	0.32
	90	Hexazinone		360	0.12
	144	Propoxur	4	641	0.21
	162	Thiamethoxam		521	0.17
	170	Triclopyr		96	0.03
2004	112	Methyl bromide	5	12740	2.19
	162	Thiamethoxam	4	1488	0.26
	144	Propoxur		1162	0.20
	15	Atrazine		713	0.12
	94	Imidacloprid		332	0.06
	126	Oxamyl		78	0.01
	158	terbuthylazine		75	0.01
2005	112	Methyl bromide	5	10290	1.48
	90	Hexazinone		3418	0.49
	156	Tebuthiuron		2950	0.42
	25	Bromacil		110	0.02
	15	Atrazine	4	13268	1.91
	94	Imidacloprid		2161	0.31
	170	Triclopyr		1795	0.26
	144	Propoxur		1513	0.22
	162	Thiamethoxam		910	0.13
	41	Clomazone		336	0.05
	158	terbuthylazine		175	0.03
2006	156	Tebuthiuron	5	5450	0.61
	90	Hexazinone		4046	0.45
	94	Imidacloprid	4	12367	1.38
	15	Atrazine		11020	1.23
	170	Triclopyr		2563	0.29
	144	Propoxur		1833	0.20
	105	Metalaxyl		332	0.04
	158	terbuthylazine		150	0.02
2007	156	Tebuthiuron	5	5590	1.01
	90	Hexazinone		3110	0.56
	94	Imidacloprid	4	12924	2.33
	15	Atrazine		3823	0.69
	170	Triclopyr		2678	0.48
	22	Bentazone		2208	0.40
	105	Metalaxyl		646	0.12
	144	Propoxur		364	0.07
2008	156	Tebuthiuron	5	3935	0.40
	90	Hexazinone		154	0.02
	94	Imidacloprid	4	14802	1.49
	41	Clomazone		4704	0.47
	170	Triclopyr		3754	0.38
	144	Propoxur		367	0.04
	15	Atrazine		113	0.01
2009	156	Tebuthiuron	5	10855	1.26
	90	Hexazinone		5674	0.66
	134	Picloram		480	0.06
	146	Quinclorac		315	0.04
	25	Bromacil		215	0.02
	41	Clomazone	4	13056	1.52
	94	Imidacloprid		5955	0.69

	170	Triclopyr		3955	0.46
	144	Propoxur		1869	0.22
	92	Imazapic		1050	0.12
	111	Methomyl		900	0.10
	13	Amicarbazone		875	0.10
	22	Bentazone		864	0.10
	105	Metalaxyl		696	0.08
	162	Thiamethoxam		465	0.05
	15	Atrazine		409	0.05
	126	Oxamyl		149	0.02
2010	90	Hexazinone	5	8227	0.86
	156	Tebuthiuron		2130	0.22
	41	Clomazone	4	19680	2.05
	94	Imidacloprid		3781	0.39
	170	Triclopyr		2640	0.28
	144	Propoxur		2394	0.25
	15	Atrazine		1450	0.15
	162	Thiamethoxam		950	0.10
	105	Metalaxyl		904	0.09
	92	Imazapic		378	0.04
	126	Oxamyl		155	0.02
	22	Bentazone		96	0.01
2011	90	Hexazinone	5	4560	0.48
	156	Tebuthiuron		1550	0.16
	41	Clomazone	4	11933	1.27
	170	Triclopyr		6163	0.65
	94	Imidacloprid		3553	0.38
	144	Propoxur		2376	0.25
	162	Thiamethoxam		1917	0.20
	15	Atrazine		1500	0.16
	92	Imazapic		1092	0.12
	13	Amicarbazone		700	0.07
	22	Bentazone		624	0.07
	105	Metalaxyl		550	0.06

Annex 5: Imported formulated products containing active ingredients of primary concern

Human health

CompoundName	Abamectin

Sum of Volume_ai_kg	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Agrometic 1.8% EC	23	40	16	41	45	79	82	45	72	444
Moz Abamec Plus 18% EC								144	43	187
Volcano Agromectin 1.8% EC		18								18
Grand Total	**23**	**58**	**16**	**41**	**45**	**79**	**82**	**189**	**115**	**649**

CompoundName	Aldicarb

Sum of Volume_ai_kg	2003	2004	2005	Grand Total
Aldicarb 15% GR	570			570
Temik 15% GR	480	90		570
Volcano Aldicarb 15% GR	360	84	1710	2154
Grand Total	**1410**	**174**	**1710**	**3294**

CompoundName	Aluminium phosphide

Sum of Volume_ai_kg	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Aluminium Phosphide 57% FT		1262									1262
Falfume 57% FT			4560		3421	5016			7866		20863
Fumaphos 56% FT		3929	194	212	71	24					4428
Moz Aluminium Phosphide 56% FT										700	700
Phosgard 56% FT	847	1129	847	118	118	118	1164	259	294	823	5715
Quickphos 56% FD			1613			335					1948
Volcano Alluminium Phosphide 57% FT			570	1890	2457	3432		3711	8846	6823	27728
Grand Total	**847**	**6319**	**7783**	**2219**	**6066**	**8925**	**1164**	**3969**	**17006**	**8346**	**62645**

CompoundName	Fenamiphos

Sum of Volume_ai_kg	2002	2003	2005	2006	2007	Grand Total
Nemacur 10% GR		50				50
Nemacur 40% EC	200	300				500
Volamiphos 40% EC		300	800	410	600	2110
Grand Total	**200**	**650**	**800**	**410**	**600**	**2660**

CompoundName	Methomyl

Sum of Volume_ai_kg	2009	Grand Total
Kuik	900	900
Grand Total	**900**	**900**

CompoundName	Mevinphos

Sum of Volume_ai_kg	2003	Grand Total
Universal Mevinfos 15% EC	150	150
Grand Total	**150**	**150**

CompoundName	Monocrotophos

Sum of Volume_ai_kg	2003	2004	2007	Grand Total
Phoskill 40% SC		200	480	680
Universal Monocrotofos 40% SL	200			200
Grand Total	**200**	**200**	**480**	**880**

CompoundName	Oxamyl

Sum of Volume_ai_kg	2004	2005	2007	2008	2009	2010	2011	Grand Total
Villa Platoon 31% SL	78							78
Vydate 31% SL		50	37	93	149	155	93	577
Grand Total	**78**	**50**	**37**	**93**	**149**	**155**	**93**	**654**

CompoundName	Terbufos

Sum of Volume_ai_kg	2008	2009	Grand Total
Bongo		6750	6750
Rotam Terbufos 15% GR	4650		4650
Grand Total	**4650**	**6750**	**11400**

CompoundName	Diuron

Sum of Volume_ai_kg	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Acticide EPW							2			2
Diuron 80% SC	7200	1600			2592	4800				16192
Rocima 363 N							1	1		2
Volcano Diuron 800 SC	13200	43072	40976	40312	20480	28768	48896	37888	43312	316904
Grand Total	**20400**	**44672**	**40976**	**40312**	**23072**	**33568**	**48899**	**37889**	**43312**	**333100**

CompoundName	Mancozeb										
Sum of Volume_ai_kg											
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand Total**
Dithan M 45 800 WP		800	4000	1600							6400
Dithane M 60 OS									390		390
Dithane NT 80% WP										800	800
Mancozeb 80% WP	1200	3440									4640
Metamin Fae Pm 72% WP										627	627
Milor								2624			2624
Milthane Super 80% WP									16000		16000
Policar MZ 80% WP										1408	1408
Ridomil Gold MZ 68 WG		1088	2304		346	576	1382			64	5760
Sunstar Super 72% WP									3200		3200
Unilax 72% WP			144			40					184
Unizeb 80% WP	800	3200	3600								7600
Uthane 80% WP			6400		4000	1600					12000
Volcano Crater MX 72% WP					2560	5120		2568	2432	3776	16456
Volcano Mancozeb 80% WP		6720	28400	18480	16760	23600	14400	24811	31552	54400	219123
Grand Total	**2000**	**15248**	**44848**	**20080**	**23666**	**30936**	**15782**	**30003**	**53574**	**61075**	**297212**

Environment

CompoundName	Lambda-cyhalothrin									
Sum of Volume_ai_kg										
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand Total**
Cyclon 10 EC						2				2
Demand 2.5 CS		15								15
Duduthrin 5% EC								250		250
Fortis K 5% EC		1538	1641	3403	888	4949	2138	1503	1750	17808
Fortis Ultra 4.75% EC	375									375
Fortis Xtra 8.8% EC	2	1500	2069							3571
Icon 10 CS						45				45
Icon 10% WP	317	2334	6070	67	98	50			133	9069
Icon 2,5% EC	63	12	38	24	60	72				268
Iconet 2.5% CS	33	427	68	6						535
Karate 5% CS			18	651	33					702
Karate 5% EC	1368	2079	720				18			4185
Karate Zeon 5% CS						17			29	45
Lambda cyhalothrin 5% EC		88	53		1505					1645
Moz Lambda-Cyhalothrin 5% EC									6	6
Revival 10% WP							12033	21430		33463
Revival 25% EC						750	1595		750	3095
Zakaka Pro 64,8% EC			260	1166	1680	2160	1020	2021	3144	11451
Zakanaka Top 10% EC			510	3235	1673	1590	1634	3839	3630	16110
Zakanaka K 6% EC			300	3146	2280	3630	1966	1567	3318	16207
Zakanaka Topro 68,8% EC			630							630
Grand Total	**2158**	**7992**	**12377**	**11698**	**8216**	**13263**	**20403**	**30610**	**12760**	**119476**

CompoundName	Acetochlor									
Sum of Volume_ai_kg										
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand Total**
Acetochlor 90% EC	2700					3105				5805
Bullet 70% SC		126	75		126	126				453
Villa Acetochlor 90% EC			13320	3204						16524
Volcano Acetochlor 90% EC	11952	33642	45666	38250	30465	69008	66996	80856	57456	434291
Grand Total	**14652**	**33768**	**59061**	**41454**	**30591**	**72239**	**66996**	**80856**	**57456**	**457073**

CompoundName	Imidacloprid									
Sum of Volume_ai_kg										
	2002	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand Total**
Bandit 35% SC					316	4756	3290	1629	1925	11916
Bandit 70% WG								2013		2013
Confidor 20% SL	129		162		104	140				535
Courage 60% FS			936							936
Courage 70% WS				12187	11900	9660	2013			35760
Gaucho 70% WS	140		1							141
Imidabiogel 2,15% PC					2		161	62	86	312
Imidacel 20% SL								77	300	377
Imidagold 20% SL					160	40	10			210
Maxforce Quantum RB									0	0
Midaclordan									500	500
Monceren GT 390 FS			140							140
Moz Imidacloprid 35% SC									42	42
Premise 35% SC							1			1
Protect 20% SL		332	730	180	400	202	480		700	3024
Quick Bait Spray Fly Bait									0	0
Seed Plus 30% WS					1	5				6
Thunder 145 O-TEQ			192		40					232
Grand Total	**269**	**332**	**2161**	**12367**	**12924**	**14802**	**5955**	**3781**	**3553**	**56144**

CompoundName	Methyl bromide			
Sum of Volume_ai_kg				
	2003	**2004**	**2005**	**Grand Total**
Volcano Methyl Bromide 100 %GA	10290	12740	10290	33320
Grand Total	**10290**	**12740**	**10290**	**33320**

CompoundName	Tebuthiuron								
Sum of Volume_ai_kg									
	2003	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand Total**
Tebuthiuron 50% SC	2200				1400				3600
Volcano Bundu 50% SC		110			35	215			360
Volcano Tebuthiuron 500 SC	640	2840	5450	5590	2500	10640	2130	1550	31340
Grand Total	**2840**	**2950**	**5450**	**5590**	**3935**	**10855**	**2130**	**1550**	**35300**

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The WHO Recommended Classification of Pesticides by Hazard

and

Guidelines to Classification 2009

World Health Organization

IPCS
International Programme on Chemical Safety

IOMC INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS
A cooperative agreement among FAO, ILO, UNEP, UNIDO, UNITAR, WHO & OECD

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THE WHO RECOMMENDED CLASSIFICATION OF PESTICIDES BY HAZARD AND GUIDELINES TO CLASSIFICATION 2009

The WHO Recommended Classification of Pesticides by Hazard was approved by the 28th World Health Assembly in 1975 and has since gained wide acceptance. When it was published in the WHO Chronicle, 29, 397-401 (1975), an annex, which was not part of the Classification, illustrated its use by listing examples of classification of some pesticidal active ingredients and their formulations. Later suggestions were made by Member States and pesticide registration authorities that further guidance should be given on the classification of individual pesticides. Guidelines were first issued in 1978, and have since been revised and reissued every few years.

Up until the present revision the original guidelines approved by the World Health Assembly in 1975 have been followed without amendment. In December, 2002 the United Nations Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals (UNCETDG/GHS) approved a document called "*The Globally Harmonized System of Classification and Labelling of Chemicals*" with the intent to provide a globally-harmonized system[1] (GHS) to address classification of chemicals, labels, and safety data sheets. The GHS (with subsequent revisions) is now being widely used for the classification and labeling of chemicals worldwide. For this revision of the Classification the WHO Hazard Classes have been aligned in an appropriate way with the GHS Acute Toxicity Hazard Categories for acute oral or dermal toxicity as the starting point for allocating pesticides to a WHO Hazard Class (with adjustments for individual pesticides where required). It is anticipated that few of the more toxic pesticides will change WHO Hazard Class as a result of this change. As has always been the case, the classification of some pesticides has been adjusted to take account of severe hazards to health other than acute toxicity (as described in Part II). The GHS Acute Toxicity Hazard Category for each pesticide is now presented alongside the existing information.

The document is arranged as follows:

Part I: Overarching principles for the classification of pesticides as recommended by the World Health Assembly. These principles continue to apply, but the World Health Assembly Resolution envisaged that the classification criteria might need to be developed with time and increasing experience. The guide-points originally proposed in 1975 are now being aligned with the corresponding Acute Toxicity Hazard Categories from the GHS.

Part II: Guidelines to Classification. Individual products are classified in a series of tables, according to the oral or dermal toxicity of the technical product. The tables are subject to review periodically.

The toxicity values are intended to be a guide only. Formulations should be separately classified using the methods set out on pages 4 (single technical product) and 7 (mixtures) and the table in Part I. To assist in the classification of formulations, an annex is provided giving numerical tables from which the classification may also be derived.

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[1] See http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html.

Comments on Part II of the document are welcome, together with proposals for new entries. These should be addressed to the International Programme on Chemical Safety, World Health Organization, 1211 Geneva 27, Switzerland, and should include supporting data on the compound being commented on or proposed.

This document is a revision of the document previously issued as ISBN 92 4 154663 8.

PART I
RECOMMENDED CLASSIFICATION OF PESTICIDES BY HAZARD

Extract from WHO Chronicle, 29: 397-401 (1975)

In 1973, the WHO Executive Board asked the Director-General of WHO to take steps to develop a tentative classification of pesticides that would distinguish between the more and the less hazardous forms of each pesticide. A proposal for a WHO recommended classification of pesticides by hazard was accordingly prepared, taking into account the views of members of the WHO Expert Advisory Panel on Insecticides and other expert advisory panels with special competence and interest in pesticide technology, as well as the comments of WHO Member States and of two international agencies. This proposal was adopted by the Twenty-eighth World Health Assembly, which recommended the use of the classification by Member States, international agencies, and regional bodies.

The text below is reproduced from the Proposal[2] which was adopted by the World Health Assembly in 1975.

The hazard referred to in this Recommendation is the acute risk to health (that is, the risk of single or multiple exposures over a relatively short period of time) that might be encountered accidentally by any person handling the product in accordance with the directions for handling by the manufacturer or in accordance with the rules laid down for storage and transportation by competent international bodies.

Any classification based on biological data can never be treated as final. In the assessment of biological data, honest differences of opinion are inevitable and most borderline cases can be reclassified in an adjacent class. Variability or inconsistency in toxicity data due to differences in susceptibility of test animals, or to experimental techniques and materials used can also result in differing assessments. The classification criteria are guide-points intended to supplement but never to substitute for special knowledge, sound clinical judgement or experience with a compound. Reappraisal might be necessary from time to time.

Basis of classification

The classification distinguishes between the more and the less hazardous forms of each pesticide in that it is based on the toxicity of the technical compound and on its formulations. [In particular, allowance is made for the lesser hazards from solids as compared with liquids.][3]

The classification is based primarily on the acute oral and dermal toxicity to the rat since these determinations are standard procedures in toxicology. Where the dermal LD_{50}[4] value of a compound is such that it would place it in a more restrictive class than the oral LD_{50} value would indicate, the compound will always be classified in the more restrictive class. Provision is made for the classification of a particular compound to be adjusted if, for any reason, the acute hazard to man differs from that indicated by LD_{50} assessments alone.

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[2] Official Record of the World Health Organization 1975, No.223, Part 1, p.12

[3] Note:- this distinction is not made in the GHS and no longer applies to the WHO Classification

[4] The LD_{50} value is a statistical estimate of the number of mg of toxicant per kg of bodyweight required to kill 50% of a large population of test animals.

Application of the criteria for classification

(a) Where it is shown that for a particular compound the rat is not the most suitable test animal (for example, if another species is conspicuously more sensitive or more closely resembles man in its reaction) then the classification of that compound should take this into account.

(b) In practice, the majority of classifications will be made on the acute oral LD_{50} value. However, dermal toxicity must always be considered since it has been found that, under most conditions of handling pesticides, a high proportion of the total exposure is dermal. Classification based on dermal data in a class indicating a great risk is necessary when the dermal LD_{50} values indicate greater hazard than oral LD_{50} values.

(c) If the active ingredient produces irreversible damage to vital organs, is highly volatile, is markedly cumulative in its effect, or is found after direct observations to be particularly hazardous or significantly allergenic to man, then adjustments to the classification can be made by classifying the compound in a class indicating a higher hazard. Alternatively, if it can be shown that the preparation is less toxic or hazardous than expected from consideration of the LD_{50} values of the ingredient or ingredients, or for any other reason, adjustments should be made by classifying the compound in a class indicating a lower hazard.

(d) In certain special cases the acute oral or dermal LD_{50} values of the compound or formulation should not be used as the main basis for classification. In such cases (for example, aerosol preparations, other special formulations and fumigants), more appropriate criteria should be used.

(e) It is highly desirable that, whenever practicable, toxicological data for each formulation to be classified should be available from the manufacturer. However, if such data are not obtainable, then the classification may be based on proportionate calculations from the LD_{50} values of the technical ingredient or ingredients, according to the following formula:

$$\frac{LD_{50}\ active\ ingredient \times 100}{Percentage\ of\ active\ ingredient\ in\ formulation}$$

If the formulation contains more than one ingredient (including solvents, wetting agents, etc.) of significant toxicity-enhancing properties, then the classification should correspond to the toxicity of the mixed ingredients.

(f) With a few exceptions, pesticides have low volatility and therefore no criteria are at present set out for volatility in this Recommendation. The inclusion of such criteria is unlikely to affect the classification of pesticides by hazard except in the case of volatile fumigants used in agriculture and food storage. On the other hand, when the criteria are applied to pesticide formulations based on solvents or to other chemicals, account must be taken of volatility and consequent inhalation toxicity.

Effects of classification on labeling[5]

While no specific symbols to identify classes are included in the Recommendation, the following are the general implications of the classification as regards labelling.

The aim should be uniformity in the statement on the nature of the risk (by phrase and/or symbol) on the label of the product, irrespective of the country of origin or use. Labels of products classified in classes Ia and Ib should bear a symbol indicating a high degree of hazard (usually a type of skull and crossbones) and a signal word or phrase, e.g. POISON or TOXIC. The presentation of the symbol and word or phrase, in terms of colour, size and shape should ensure that they are given sufficient prominence on the label.

The text should be in the local language and for all formulations should include the approved name of the active ingredient or ingredients, the method of use, and precautions to be taken in use. For classes Ia and Ib, symptoms and immediate treatment of poisoning should also be included.

The detailed precautions necessary for the use of a pesticide depend on the nature of the formulation and the pattern of use and are best decided by a pesticide registration authority when accepting a commercial label.

There are international agreements on symbols to denote hazards from materials which are inflammable, corrosive, explosive, etc., and these should be consulted and used where appropriate.

Revised criteria for classification (introduced for 2009 update)

The table showing the Recommended Criteria for Classification from the original World Health Assembly Proposal is not shown because it is no longer used. WHO now uses the Acute Toxicity Hazard Categories from the GHS[6] as the starting point for classification. This change is consistent with the 1975 World Health Assembly Resolution which envisaged that the WHO Classification would be further developed with time in consultation with countries, international agencies and regional bodies. The GHS meets this requirement as a classification system with global acceptance following extensive international consultation.

WHO Class		**LD_{50} for the rat (mg/kg body weight)**	
		Oral	**Dermal**
Ia	**Extremely hazardous**	**< 5**	**< 50**
Ib	**Highly hazardous**	**5–50**	**50–200**
II	**Moderately hazardous**	**50–2000**	**200–2000**
III	**Slightly hazardous**	**Over 2000**	**Over 2000**
U	**Unlikely to present acute hazard**	**5000 or higher**	

Details of how the WHO Classification has been aligned with the GHS Acute Toxicity Hazard Categories are presented in Part II.

[5] See *International Code of Conduct on the Distribution and Use of Pesticides*, FAO (2003), available at http://www.fao.org/docrep/005/Y4544E/y4544e00.HTM; also *Guidelines on Good Labelling Practice for Pesticides*, FAO (1995), available at http://www.fao.org/ag/AGP/AGPP/Pesticid/Code/Download/label.pdf

[6] See http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html. The categories for oral and dermal routes are used.

PART II
GUIDELINES TO CLASSIFICATION OF PESTICIDES BY HAZARD

The main section of the guidelines consists of five tables preceded by notes on their use. In the tables, active ingredients (technical grade) have been classified as follows:

The tables are arranged in alphabetical order.

In addition, the following tables show the details stated:

NOTES ON THE USE OF THE TABLES IN CLASSIFICATION

The final classification of any product is intended to be by formulation

The classification given in the tables below is of active ingredients, and only forms the starting point for the final classification of an actual formulation. It is by far preferable that the final classification of a formulation should be based on toxicity data obtained on that formulation by the manufacturer: the criteria set out in the table of the Classification in Part I are then applied to this first-hand data. Only if this is not available should the formula be used, as shown in Part I on page 4 to extrapolate the LD_{50} of the formulation from that of the technical product. In this event, the single oral or dermal value of the LD_{50} given in the tables below should be used in the formula. See also the Annex on page 54.

The following important points should be noted.

1. While the classification deals only with the acute risk to health, evaluations of other effects, including cancer, have been completed for many compounds for registration purposes. Where other effects have been shown to occur in man, these are noted in the 'Remarks' column and may have in some cases resulted in an adjusted classification.
2. Wherever possible, the data are listed under internationally approved common names, or if such names are not at present available, under nationally approved names. Some other common names appear in the alphabetic index pp. 65-78. Trade names are not given since there are many of these.
3. A list of references that may be used for the identification of pesticides is given at the end of these introductory notes, and the manufacturer should always assist by specifying any existing approved or common names for his product.
4. It is not possible to include classification of mixtures of pesticides in the guidelines: very many of these are marketed with varying concentrations of active constituents. There are three possible approaches to the classification of mixtures - in order of preference:
   (a) require the formulator to obtain reliable acute oral and dermal toxicity data for rats on the actual mixture as marketed: or
   (b) classify the formulation according to the most hazardous constituent of the mixture as if that constituent was present in the same concentration as the total concentration of all active constituents: or
   (c) apply the formula:

$$\frac{C_a}{T_a} + \frac{C_b}{T_b} + \ldots \frac{C_z}{T_z} \equiv \frac{100}{T_m}$$

Where C = the % concentrations of constituent A, B ... Z in the mixture
T = the oral LD_{50} values of constituents A, B ...Z
T_m = the oral LD_{50} value of the mixture.

The formula can also be used for dermal toxicities provided that this information is available on the same species for all constituents. The use of this formula does not take into account any potentiation or protective phenomena.

5. In the tables below, single figures have been given as LD_{50} values for classification purposes, using the route as described in the table. Where several LD_{50} values have been published, the lowest deemed reliable is used. Where a sex difference occurs in LD_{50} values, the value for the more sensitive sex is used. A number of adjustments to Classification have been made in respect of some pesticides and these are explained. A borderline case has been classified in the more or less hazardous class after consideration of its toxicology and use experience.

6. In the former WHO Classification scheme pesticides were classified on the basis of the physical state of the technical product. A distinction between liquids and solids is no longer made.

7. In Table 5, a number of pesticides are listed as unlikely to present any acute hazard in normal use. The WHO classification is open-ended but it is clear that there must be a point at which the acute hazard posed by the use of these compounds is so low as to be negligible provided that the precautions are taken that should be used in dealing with any chemical. In compiling this table, it has been assumed that this point is an LD_{50} of 5000 mg/kg bw or greater (in line with the upper limit for classification in the GHS). However, it should not be overlooked that in formulations of these technical products, solvents or vehicles may present a greater hazard than the actual pesticide and therefore classification of a formulation in one of the higher hazard classes may be necessary.

8. The WHO Classification is not limited to chemical pesticides. Biological pesticides can also be included if a suitable evaluation is available (*Bacillus thuringiensis* is included based on Environmental Health Criteria Document 217).

9. The toxicity data for pyrethroids is highly variable according to isomer ratios, the vehicle used for oral administration, and the husbandry of the test animals e.g. fasting prior to dosing. The variability is reflected in the prefix 'c' before LD_{50} values. The single LD_{50} value chosen for classification purposes is generally based on administration in corn oil and can be much lower than that in aqueous solutions. This underlines the need for classification by formulation if the classification is to reflect true hazard.

ENTRIES AND ABBREVIATIONS USED IN THE TABLES

New information since the previous edition is indicated by *italics*.

Column 1: Common name. [ISO] denotes common name of the active ingredient approved by the International Organization for Standardization. Such names are, when available, preferred by WHO to all other common names. However, attention is drawn to the fact that some of these names may not be acceptable for national use in some countries. If the letters ISO appear within parentheses (ISO), this indicates that ISO has standardized (or is in the process of standardizing) the name of the base, but not the name of the derivative listed in column 1. For example, fentin acetate (ISO) indicates that fentin is an ISO name, but fentin acetate is not. ISO* denotes pending ISO approval of the name. C denotes chemical, trivial, or other common name.

Column 2: CAS Registry number: The number for the chemical, not those for e.g. different esters or salts are given.

Column 3: UN number refers to the UN Recommendations on the transport of dangerous goods, Eleventh revision (1999). This is given only for active ingredients in Tables 1, 2, 3 or 4, since so few ingredients in Table 5 have UN numbers. The UN number refers only to the active ingredient; formulations are likely to have different numbers, since the ingredient may, for example, be dissolved in a solvent - and liquid products have different UN numbers, which depends on their flammability.

Column 4: Chemical type. Only a limited number of chemical types are shown. Most have some significance in the sense that they may have a common antidote, or may be confused in the nomenclature with other chemical types e.g. thiocarbamates are not cholinesterase inhibitors and do not have the same effects as carbamates. Chemical type is also a determinant of the UN numbering system. These chemical classifications are included only for convenience, and do not represent a recommendation on the part of the World Health Organization as to the way in which the pesticides should be classified. It should, furthermore, be understood that some pesticides may fall into more than one type.

AS	Arsenic compound
BP	Bipyridylium derivative
C	Carbamate
CO	Coumarin derivative
CU	Copper compound
HG	Mercury compound
NP	Nitrophenol derivative
OC	Organochlorine compound
OP	Organophosphorus compound
OT	Organotin compound
PAA	Phenoxyacetic acid derivative
PZ	Pyrazole
PY	Pyrethroid
T	Triazine derivative
TC	Thiocarbamate

Column 5: Physical state. Refers only to the active ingredient. L denotes liquid, including solids with a melting point below 50°C; oil denotes oily liquids and S solids, including waxes. The physical state may affect the exposure potential, and thus the absorbed amount of the chemical, and was taken into account when determining classification under the previous scheme.

Column 6: Main use. In most cases only a single use is given. This is only for identification purposes and does not exclude other uses.

AC	acaricide
AP	aphicide
B	bacteriostat (soil)
FM	fumigant
F	fungicide, other than for seed treatment
FST	fungicide, for seed treatment
H	herbicide
I	insecticide
IGR	insect growth regulator
Ix	ixodicide (for tick control)
L	larvicide
M	molluscicide
MT	miticide
N	nematocide
O	other use for plant pathogens
PGR	plant growth regulator
R	rodenticide
RP( )	repellant (species)
-S	applied to soil: not used with herbicides or plant growth regulators
SY	synergist

Column 7: GHS: This column indicates the classification of the pesticide according to "*The Globally Harmonized System of Classification and Labelling of Chemicals*" (GHS)[7]. The value shown in the column is the Acute Toxic Hazard Category according to the GHS criteria, which in turn is derived from the acute toxicity estimate value for the substance. In the majority of cases the acute toxicity estimate will be the experimentally-derived LD_{50} value for oral exposure. A comparison of the criteria (as LD_{50} values) used for the different classes in the former WHO Scheme or for GHS categories is shown in the tables below. The GHS table shows only a simplified summary; for full details of classification according to GHS the official publication of the GHS should be consulted.

Former WHO Classification Scheme

Class		***LD_{50} for the rat (mg/kg body weight)***			
		Oral		*Dermal*	
		Solids	*Liquids*	*Solids*	*Liquids*
Ia	*Extremely hazardous*	*5 or less*	*20 or less*	*10 or less*	*40 or less*
Ib	*Highly hazardous*	*5 - 50*	*20 - 200*	*10-100*	*40 – 400*
II	*Moderately hazardous*	*50 - 500*	*200 - 2000*	*100-1000*	*400 – 4000*
III	*Slightly hazardous*	*Over 500*	*Over 2000*	*Over 1000*	*Over 4000*

GHS Classification

GHS Category	**Classification criteria**			
	Oral		Dermal	
	LD_{50} [a] (mg/kg bw)	Hazard Statement	LD_{50} [b] (mg/kg bw)	Hazard Statement
Category 1	< 5	Fatal if swallowed	< 50	Fatal in contact with skin
Category 2	5 - 50	Fatal if swallowed	50 - 200	Fatal in contact with skin
Category 3	50 - 300	Toxic if swallowed	200 - 1000	Toxic in contact with skin
Category 4	300 - 2000	Harmful if swallowed	1000 - 2000	Harmful in contact with skin
Category 5	2000 - 5000	May be harmful if swallowed	2000 - 5000	May be harmful in contact with skin

[a] For oral data the rat is the preferred species, though data from other species may be appropriate when scientifically justified

[b] For dermal data the rat or rabbit are the preferred species, though data from other species may be appropriate when scientifically justified

[7] See http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html. The categories for oral and dermal routes are used

The former WHO Classification scheme applied different criteria to liquids and solids, but the GHS does not make a similar distinction and applies the same criteria. The GHS cut-off values for Category 2 and Category 3 are lower than the values which applied to liquids under the former WHO scheme, such that some liquids allocated to Class Ib would be placed in the lower GHS Category 3 (specifically pesticides with oral LD_{50} values in the range 50-200 mg/kg bw). In aligning the WHO scheme with the GHS criteria there was no intention to "lower" the classification of pesticides previously considered to be "Highly hazardous". Therefore, the classification of this limited number of liquid pesticides has been adjusted such that they remain in Class Ib. The revised criteria for the WHO classification scheme are shown in Part I (page 5).

Column 8: LD_{50}. The LD_{50} value is a statistical estimate of the number of mg of toxicant per kg of body weight required to kill 50% of a large population of test animals: the rat is used unless otherwise stated. Usually a single value, but sometimes a range is given. "c" preceding the value indicates that it is a value within a wider than usual range, adopted for classification purposes. When several different values are reported in the literature, the lowest is reported and used as the basis of classification, unless there are clear indications that a higher value is more reliable. Oral route values are used unless the dermal route values place the compound in a more hazardous class, or unless the dermal values are significantly lower than the oral values, although in the same class. Dermal LD_{50} values are indicated with the letter D.

Column 9: Remarks. This column is used to indicate cases in which the classification of a technical product has been adjusted (i.e., the oral LD_{50} value is not directly used as the basis of classification); Major irritant properties are also noted although they do not affect the classification. Sources of further information may also be given here: DS denotes a WHO/FAO Data Sheet on Pesticides, EHC an Environmental Health Criteria monograph, HSG a Health and Safety Guide, IARC IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, ICSC an International Chemical Safety Card, JMPR an evaluation by the Joint FAO/WHO Meeting on Pesticide Residues and JECFA an evaluation by the the Joint FAO/WHO Expert Committee on Food Additives. These publications (with the exception of IARC Monographs) can be found on the IPCS web site (http://www.who.int/ipcs/).

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Table 1. Extremely hazardous (Class Ia) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Aldicarb [ISO]	116-06-3	2757	C	S	I-S	1	0.93	DS 53; EHC 121; HSG 64; IARC 53; ICSC 94; JMPR 1993, 1996a
Brodifacoum [ISO]	56073-10-0	3027	CO	S	R	1	0.3	DS 57; EHC 175; HSG 93
Bromadiolone [ISO]	28772-56-7	3027	CO	S	R	1	1.12	DS 88; EHC 175; HSG 94
Bromethalin [ISO]	63333-35-7	2588		S	R	1	2	
Calcium cyanide [C]	592-01-8	1575		S	FM	2	39	Adjusted classification; see note 1; ICSC 407
Captafol [ISO]	2425-06-1			S	F	5	5000	Adjusted classification; see note 2; HSG 49; IARC 53; ICSC 119; JMPR 1978, 1986a; see note 3
Chlorethoxyfos [ISO]	54593-83-8	3018	OP	L	I	1	1.8	Extremely hazardous by skin contact (LD_{50} = 12.5 mg/kg); *ICSC 1681*
Chlormephos [ISO]	24934-91-6	3018	OP	L	I	2	7	*ICSC 1682*
Chlorophacinone [ISO]	3691-35-8	2588		S	R	1	3.1	DS 62; EHC 175
Difenacoum [ISO]	56073-07-5	3027	CO	S	R	1	1.8	EHC 175; HSG 95
Difethialone [ISO]	104653-34-1	2588		S	R	1	0.56	EHC 175
Diphacinone [ISO]	82-66-6	2588		S	R	1	2.3	EHC 175
Disulfoton [ISO]	298-04-4	3018	OP	L	I	1	2.6	DS 68; JMPR 1992, 1997a; *ICSC 1408*
EPN	2104-64-5	2783	OP	S	I	2	14	See note 4; ICSC 753
Ethoprophos [ISO]	13194-48-4	3018	OP	L	I-S	2	D26	DS 70; JMPR 2000; *ICSC 1660*; *[Oral LD_{50} = 33 mg/kg]*
Flocoumafen	90035-08-8	3027		S	R	1	0.25	EHC 175; ICSC 1267
Hexachlorobenzene [ISO]	118-74-1	2729	OC	S	FST	5	D10000	Adjusted classification (notes 3 and 5); IARC 79; ICSC 895; *EHC 195*
Mercuric chloride [ISO]	7487-94-7	1624	HG	S	F-S	1	1	See note 3; ICSC 979
Mevinphos [ISO]	26718-65-0	3018	OP	L	I	1	D4	DS 14; ICSC 924; JMPR 1998b; *[Oral LD_{50} = 3.7 mg/kg]*
Parathion [ISO]	56-38-2	3018	OP	L	I	2	13	See note 3; DS 6; HSG 74; IARC 30, Suppl. 7; ICSC 6; JMPR 1996b
Parathion-methyl [ISO]	298-00-0	3018	OP	L	I	2	14	See note 3; DS 7; EHC 145; HSG 75; ICSC 626; JMPR 1985c, 1996b

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Phenylmercury acetate [ISO]	62-38-4	1674	HG	S	FST	2	24	Adjusted classification; see notes 3 and 6; ICSC 540
Phorate [ISO]	298-02-2	3018	OP	L	I	1	2	DS 75; JMPR 1997b, 2005; *ICSC 1060*
Phosphamidon	13171-21-6	3018	OP	L	I	2	7	See note 3; DS 74; ICSC 189; JMPR 1987b CAS Nos for E and Z isomers 297-99-4 and 23783-98-4
Sodium fluoroacetate [C]	62-74-8	2629		S	R	1	0.2	DS 16; *ICSC 484*
Sulfotep [ISO]	3689-24-5	1704	OP	L	I	1	5	ICSC 985
Tebupirimfos [ISO*]	96182-53-5	3018	OP	L	I	1	1.3	Extremely hazardous by skin contact (LD_{50} 9.4 mg/kg in rats)
Terbufos [ISO]	13071-79-9	3018	OP	L	I-S	1	c2	JMPR 1991, 2004

EHC = Environmental Health Criteria Monograph; DS = Pesticide Data Sheet; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

Notes to Class Ia

1. Calcium cyanide is in Class Ia as it reacts with moisture to produce hydrogen cyanide gas. The gas is not classified under the WHO system (see Table 8).
2. Captafol is carcinogenic in both rats and mice.
3. The international trade of captafol, hexachlorobenzene, mercury compounds, parathion, parathion-methyl, and phosphamidon is regulated by the Rotterdam convention on Prior Informed Consent (see http://www.pic.int/), which entered into force on 24 February 2004. See Table 7, p. 51
4. EPN has been reported as causing delayed neurotoxicity in hens.
5. Hexachlorobenzene has caused a serious outbreak of porphyria in humans. The use and production of hexachlorobenzene is severely restricted by the Stockholm convention on persistent organic pollutants, which entered into force on 17 May, 2004. See http://www.pops.int/
6. Phenylmercury acetate is highly toxic to mammals and very small doses have produced renal lesions: teratogenic in the rat.

THE FINAL CLASSIFICATION OF ANY PRODUCT
DEPENDS ON ITS FORMULATION
See Pages 7 & 8, and the Annex

Table 2. Highly hazardous (Class Ib) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Acrolein [C]	107-02-8	1092		L	H	2	29	EHC 127; HSG 67; IARC 63; ICSC 90
Allyl alcohol [C]	107-18-6	1098		L	H	3	64	Highly irritant to skin and eyes; ICSC 95; *Adjusted classification (see note 3)*
Azinphos-ethyl [ISO]	2642-71-9	2783	OP	S	I	2	12	DS 72; JMPR 1974
Azinphos-methyl [ISO]	86-50-0	2783	OP	S	I	2	16	DS 59; ICSC 826; JMPR 1992, *2009b*
Blasticidin-S	2079-00-7	2588		S	F	2	16	
Butocarboxim [ISO]	34681-10-2	2992	C	L	I	3	158	JMPR 1986a; *Adjusted classification (see note 3)*
Butoxycarboxim [ISO]	34681-23-7	2992	C	L	I	3	D288	*Adjusted classification (see note 3)*
Cadusafos [ISO]	95465-99-9	3018	OP	L	N,I	2	37	JMPR 1992
Calcium arsenate [C]	7778-44-1	1573	AS	S	I	2	20	EHC 18, 224; IARC 84; ICSC 765; JMPR 1969
Carbofuran [ISO]	1563-66-2	2757	C	S	I	2	8	DS 56; ICSC 122; JMPR 1997b, 2003b, *2009a; See note 2.*
Chlorfenvinphos [ISO]	470-90-6	3018	OP	L	I	2	31	ICSC 1305; JMPR 1995b
3-Chloro-1,2-propanediol [C]	96-24-2	2689		L	R	3	112	*Adjusted classification (see notes 1 and 3)*
Coumaphos [ISO]	56-72-4	2783	OP	S	AC,MT	2	7.1	ICSC 422; JMPR 1991
Coumatetralyl [ISO]	5836-29-3	3027	CO	S	R	2	16	
Cyfluthrin [ISO]	*68359-37-5*		*PY*	*S*	*I*	*2*	*c15*	*JMPR 2008; See note 9, p. 8*
Beta-cyfluthrin [ISO]	*68359-37-5*		*PY*	*S*	*I*	*2*	*c11*	*JMPR 2008; See note 9, p. 8*
Zeta-cypermethrin [ISO]	52315-07-8	3352	PY	L	I	3	c86	See note 9, p. 8; HSG 22; ICSC 246; *JMPR 2008; Adjusted classification (see note 3)*
Demeton-S-methyl [ISO]	919-86-8	3018	OP	L	I	2	40	DS 61, EHC 197; ICSC 705; JMPR 1990
Dichlorvos [ISO]	62-73-7	3018	OP	L	I	3	56	Volatile, DS 2; EHC 79; HSG 18; IARC 20, 53; ICSC 690; JMPR 1994; *Adjusted classification (see note 3)*
Dicrotophos [ISO]	141-66-2	3018	OP	L	I	2	22	ICSC 872
Dinoterb [ISO]	1420-07-1	2779	NP	S	H	2	25	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
DNOC [ISO]	534-52-1	2779	NP	S	I-S,H	2	25	JMPR 1965a; EHC 220; *ICSC 462*. See note 2.
Edifenphos [ISO]	17109-49-8	3018	OP	L	F	3	150	JMPR 1982. *Adjusted classification (see note 3)*
Ethiofencarb [ISO]	29973-13-5	2992	C	L	I	3	200	JMPR 1983. *Adjusted classification (see note 3)*
Famphur	52-85-7	2783	OP	S	I	2	48	
Fenamiphos [ISO]	22224-92-6	2783	OP	S	N	2	15	DS 92; ICSC 483; JMPR 1998b, 2003b
Flucythrinate [ISO]	70124-77-5	3352	PY	L	I	3	c67	JMPR 1986b; see note 9, p.8; *Adjusted classification (see note 3)*
Fluoroacetamide [C]	640-19-7	2588		S	R	2	13	*ICSC 1434*. See note 2
Formetanate [ISO]	22259-30-9	2757	C	S	AC	2	21	
Furathiocarb	65907-30-4	2992	C	L	I-S	2	42	
Heptenophos [ISO]	23560-59-0	3018	OP	L	I	3	96	*Adjusted classification (see note 3)*
Isoxathion [ISO]	18854-04-8	3018	OP	L	I	3	112	*Adjusted classification (see note 3)*
Lead arsenate [C]	7784-40-9	1617	AS	S	L	2	c10	*EHC 18*, 224; IARC 84; ICSC 911; JMPR 1969
Mecarbam [ISO]	2595-54-2	3018	OP	Oil	I	2	36	JMPR 1987a
Mercuric oxide [ISO]	21908-53-2	1641	HG	S	O	2	18	ICSC 981; CICAD 50. See note 2
Methamidophos [ISO]	10265-92-6	2783	OP	S	I	2	30	HSG 79; ICSC 176; JMPR 1991, 2003b; See note 2
Methidathion [ISO]	950-37-8	3018	OP	L	I	2	25	JMPR 1998b; *ICSC 1659*
Methiocarb [ISO]	2032-65-7	2757	C	S	I	2	20	JMPR 1999
Methomyl [ISO]	16752-77-5	2757	C	S	I	2	17	DS 55, EHC 178; HSG 97; ICSC 177, JMPR 1989, 2002
Monocrotophos [ISO]	6923-22-4	2783	OP	S	I	2	14	See note 2; HSG 80; ICSC 181; JMPR 1996b
Nicotine [ISO]	54-11-5	1654		L		1	D50	ICSC 519
Omethoate [ISO]	1113-02-6	3018	OP	L	I	2	50	JMPR 1997a
Oxamyl [ISO]	23135-22-0	2757	C	S	I	2	6	DS 54; JMPR 1986b, 2003b
Oxydemeton-methyl [ISO]	301-12-2	3018	OP	L	I	3	65	JMPR 1990, 2003b; *Adjusted classification (see note 3)*
Paris green [C]	12002-03-8	1585	AS	S	L	2	22	Copper-arsenic complex
Pentachlorophenol [ISO]	87-86-5	3155		S	I,F,H	2	D80	See note 2; Irritant to skin; EHC 71; HSG 19; IARC 20, 53; ICSC 69

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Propetamphos [ISO]	31218-83-4	3018	OP	L	I	3	106	*Adjusted classification (see note 3)*
Sodium arsenite [C]	7784-46-5	1557	AS	S	R	2	10	EHC 224; IARC 84; *ICSC 1603*
Sodium cyanide [C]	143-33-9	1689		S	R	2	6	ICSC 1118; CICAD 61
Strychnine [C]	57-24-9	1692		S	R	2	16	ICSC 197
Tefluthrin	79538-32-2	3349	PY	S	I-S	2	c22	See note 9, p. 8
Thallium sulfate [C]	7446-18-6	1707		S	R	2	11	DS 10, EHC 182; ICSC 336
Thiofanox [ISO]	39196-18-4	2757	C	S	I-S	2	8	
Thiometon [ISO]	640-15-3	3018	OP	Oil	I	3	120	DS 67; ICSC 580; JMPR 1980; *Adjusted classification (see note 3)*
Triazophos [ISO]	24017-47-8	3018	OP	L	I	3	82	JMPR 1994, 2003b; *Adjusted classification (see note 3)*
Vamidothion [ISO]	2275-23-2	3018	OP	L	I	3	103	JMPR 1989*; ICSC 758; Adjusted classification (see note 3)*
Warfarin [ISO]	81-81-2	3027	CO	S	R	2	10	DS 35, EHC 175; HSG 96; ICSC 821
Zinc phosphide [C]	1314-84-7	1714		S	R	2	45	DS 24, EHC 73; ICSC 602

EHC = Environmental Health Criteria Monograph; DS= Pesticide Data Sheet; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

Notes to Class Ib

1. 3-Chloro-1,2-propanediol in nonlethal dosage is a sterilant for male rats. This compound is also known as alpha chlorhydrin.
2. The international trade of carbofuran, DNOC, fluoroacetamide, mercury compounds, methamidophos, monocrotophos and pentachlorophenol is regulated by the Rotterdam convention on Prior Informed Consent (see http://www.pic.int/), which entered into force on 24 February 2004. See Table 7, p. 51.
3. As a precautionary measure, the classification of certain liquid pesticides has been adjusted to avoid those pesticides being assigned to a less hazardous Class in the process of aligning the WHO Classification with the GHS. Details of how the WHO Classification has been aligned with the GHS Acute Toxicity Hazard Categories are described in the introductory notes for Part II.

THE FINAL CLASSIFICATION OF ANY PRODUCT
DEPENDS ON ITS FORMULATION
See Pages 7 & 8, and the Annex

Table 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Acephate [ISO]	30560-19-1		OP	S	I	4	945	JMPR 1991, 2003b, *2006b; ICSC 748*
Acifluorfen [ISO]	50594-66-6			S	H	4	1370	Strong irritant to eyes
Alachlor [ISO]	15972-60-8	2588		S	H	4	930	See note 1; DS 86; IARC 19, 36, 63; ICSC 371
Alanycarb [ISO]	83130-01-2		C	S	I	4	330	
Allethrin [ISO]	584-79-2		PY	Oil	I	4	c685	See note 9, page 8; EHC 87; HSG 24; ICSC 212; JMPR 1965a
Ametryn [ISO]	834-12-8		T	S	H	4	110	
Amitraz [ISO]	33089-61-1			S	AC	4	800	ICSC 98; JMPR 1999
Anilofos [ISO]	64249-01-0		OP	S	H	4	472	
Azaconazole	60207-31-0			S	F	4	308	
Azamethiphos [ISO]	35575-96-3		OP	S	I	4	1010	
Azocyclotin [ISO]	41083-11-8	2786	OT	S	AC	3	80	JMPR 1990, 1995b, *2006b*
Bendiocarb [ISO]	22781-23-3	2757	C	S	I	3	55	DS 52
Benfuracarb [ISO]	82560-54-1	2992	C	L	I	3	205	
Bensulide [ISO]	741-58-2	2902		L	H	3	270	ICSC 383
Bensultap [ISO]	17606-31-4			S	I	4	1100	
Bentazone [ISO]	25057-89-0			S	H	4	1100	HSG 48; ICSC 828; JMPR 1999, 2005
Bifenthrin	82657-04-3	3349	PY	S	I	3	c55	JMPR 1993
Bilanafos [ISO]	71048-99-2			S	H	3	268	
Bioallethrin [C]	584-79-2		PY	L	I	4	c700	See note 2; note 9, p. 8; ICSC 227
Bromoxynil [ISO]	1689-84-5	2588		S	H	3	190	
Bromuconazole	116255-48-2			S	F	4	365	ICSC 1264
Bronopol	52-51-7			S	B	3	254	ICSC 415
Butamifos [ISO]	36335-67-8		OP	L	H	4	630	
Butralin [ISO]	33629-47-9			S	H	4	1049	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Butroxydim [ISO]	138164-12-2			S	H	4	1635	
Butylamine [ISO]	13952-84-6	1992		L	F	4	380	Irritant to skin; ICSC 401; JMPR 1982, 1985b
Carbaryl [ISO]	63-25-2	2757	C	S	I	3	c300	DS 3; EHC 153; HSG 78; IARC 12, Suppl.7; ICSC 121; JMPR 1997b, 2002
Carbosulfan [ISO]	55285-14-8	2992	C	L	I	3	250	JMPR 1987a, 2004
Cartap [ISO]	15263-53-3			S	I	4	325	EHC 76; JMPR 1996a
Chloralose [C]	15879-93-3			S	R	4	400	
Chlordane [ISO]	57-74-9	2996	OC	L	I	4	460	See notes 3 and 4; DS 36; EHC 34; HSG 13; IARC 79; ICSC 740; JMPR 1995a
Chlorfenapyr [ISO]	122453-73-0			S	I,MT	4	441	
Chlormequat (chloride) [ISO]	999-81-5			S	PGR	4	670	ICSC 781; JMPR 2000
Chloroacetic acid [C]	79-11-8	1751		S	H	4	650	Irritant to skin and eyes; data refer to sodium salt; ICSC 235
Chlorphonium chloride [ISO]	115-78-6	2588		S	PGR	3	178	Irritant to skin and eyes
Chlorpyrifos [ISO]	2921-88-2	2783	OP	S	I	3	135	DS 18; ICSC 851; JMPR 2000
Clomazone [ISO]	81777-89-1			L	H	4	1369	
Copper hydroxide [C]	20427-59-2		CU	S	F	4	1000	
Copper oxychloride [C]	1332-40-7		CU	S	F	4	1440	
Copper sulfate [C]	7758-98-7		CU	S	F	3	300	*ICSC 751*
4-CPA [ISO]	122-88-3		PAA	S	PGR	4	850	
Cuprous oxide [C]	1317-39-1		CU	S	F	4	470	ICSC 421, EHC 200
Cyanazine [ISO]	21725-46-2		T	S	H	3	288	ICSC 391
Cyanophos [ISO]	2636-26-2		OP	L	I	4	610	
Cyhalothrin [ISO]	68085-85-8	3352	PY	Oil	Ix	3	c144	See note 9, p. 8; EHC 99; HSG 38; ICSC 858; JMPR 1985c; JECFA 2000b
Cyhexatin [ISO]	13121-70-5		OT	S	AC	3	*265*	EHC 15; JMPR 1995b, *2006b*
Cymoxanil [ISO]	57966-95-7			S	F	4	1196	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Cypermethrin [ISO]	52315-07-8	3352	PY	L	I	3	c250	See note 9, p. 8; DS 58; EHC 82; HSG 22; ICSC 246; JECFA 1996
Alpha-cypermethrin [ISO]	67375-30-8	3349	PY	S	I	3	c79	See note 9, p 8; EHC 142; JECFA 1996; *JMPR 2008*
Cyphenothrin [(1R)-isomers] [ISO]	39515-40-7	3352	PY	L	I	4	318	
Cyproconazole	94361-06-5			S	F	4	1020	
2,4-D [ISO]	94-75-7	3345	PAA	S	H	4	375	DS 37; EHC 29, 84; HSG 5; IARC 41, Suppl. 7; ICSC 33; JMPR 1998b
Dazomet [ISO]	533-74-4			S	F-S	4	640	Irritant to skin and eyes; ICSC 786
2,4-DB	94-82-6			S	H	4	700	
DDT [ISO]	50-29-3	2761	OC	S	I	3	113	See notes 3 and 4; DS 21; EHC 9, 83; IARC 53; ICSC 34; JMPR 1985c, 2001
Deltamethrin [ISO]	52918-63-5	3349	PY	S	I	3	c135	See note 9, p. 8; DS 50; EHC 97; HSG 30; IARC 53; ICSC 247; JMPR 2001
Diazinon [ISO]	333-41-5	3018	OP	L	I	4	*300*	DS 45, EHC 198; ICSC 137; JMPR 1994, 2002, *2008*
Dicamba [ISO]	1918-00-9			S	H	4	1707	ICSC 139
Dichlorobenzene [C]	106-46-7			S	FM	4	500-5000	Mixture of isomers: ortho (3) 95-50-1, meta (3) 541-73-1, para (2B) 106-46-7; *ICSC 37*
Dichlorophen [ISO]	97-23-4		OC	S	F	4	1250	
Dichlorprop [ISO]	7547-66-2			S	H	4	800	ICSC 38
Diclofop [ISO]	40483-25-2			S	H	4	565	
Dicofol [ISO]	115-32-2		OC	S	AC	4	c690	DS 81; IARC 30; ICSC 752; JMPR 1993
Difenoconazole [ISO]	119446-68-3			S	F	4	1453	*JMPR 2009b*
Difenzoquat [ISO]	43222-48-6	2588		S	H	4	470	
Dimepiperate [ISO]	61432-55-1		TC	S	H	4	946	
Dimethachlor [ISO]	50563-36-5			S	H	4	1600	
Dimethipin [ISO]	55290-64-7			S	H	4	1180	JMPR 2000, 2005

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Dimethenamid [ISO]	*87674-68-8*			*L*	*H*	*4*	*371*	*LD_{50} of P isomer is 429 mg/kg bw; JMPR 2006b*
Dimethylarsinic acid [C]	75-60-5	1572	AS	S	H	4	1350	
Dimethoate [ISO]	60-51-5	2783	OP	S	I	3	c150	DS 42; EHC 90; HSG 20; ICSC 741; JMPR 1997b, 2004
Diniconazole [ISO]	83657-24-3			S	F	4	639	
Dinobuton [ISO]	973-21-7	2779	NP	S	AC,F	3	140	
Dinocap [ISO]	39300-45-3		NP	S	AC,F	4	980	ICSC 881; JMPR 1999
Diphenamid [ISO]	957-51-7			S	H	4	970	ICSC 763
Diquat [ISO]	2764-72-9	2781	BP	S	H	3	231	Irritant to skin and eyes and damages nails; DS 40; EHC 39; HSG 52; JMPR 1994; *ICSC 1363*
Dithianon [ISO]	3347-22-6			S	F	4	640	JMPR 1993
Dodine [ISO]	2439-10-3			S	F	4	1000	JMPR 2001
Endosulfan [ISO]	115-29-7	2761	OC	S	I	3	80	DS 15; EHC 40; HSG 17; ICSC 742; JMPR 1999
Endothal-sodium [(ISO)]	125-67-9	2588		S	H	3	51	
EPTC [ISO]	759-94-4		TC	L	H	4	1652	ICSC 469
Esfenvalerate [ISO]	66230-04-4	3349	PY	S	I	3	87	JMPR 2003b; *ICSC 1516*
Ethion [ISO]	563-12-2	3018	OP	L	I	3	208	ICSC 888; JMPR 1991
Fenazaquin [ISO]	120928-09-8	2588		S	AC	3	134	
Fenitrothion [ISO]	122-14-5		OP	L	I	4	503	DS 30; EHC 133; HSG 65; ICSC 622; JMPR 2001
Fenobucarb	3766-81-2		C	S	I	4	620	
Fenothiocarb [ISO]	62850-32-2		C	S	L	4	1150	
Fenpropidin [ISO]	67306-00-7			L	F	4	1440	
Fenpropathrin [ISO]	64257-84-7	3349	PY	S	I	3	c66	See note 9, p. 8; JMPR 1994
Fenpyroximate [ISO]	*134098-61-6*			*S*	*AC*	*3*	*245*	*Highly toxic by inhalation (LC_{50} = 0.21-0.36 mg/l); JMPR 2007*
Fenthion [ISO]	55-38-9	3018	OP	L	I,L	3	D586	DS 23; ICSC 655; JMPR 1998b
Fentin acetate[(ISO)]	900-95-8	2786	OT	S	F	3	125	DS 22; EHC 15; JMPR 1992; CICAD 13

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Fentin hydroxide[(ISO)]	76-87-9	2786	OT	S	F	3	108	DS 22; EHC 15; ICSC 1283; JMPR 1992; *CICAD 13*
Fenvalerate [ISO]	51630-58-1	3352	PY	L	I	4	c450	See note 9, p. 8; DS 90; EHC 95, HSG 34; IARC 53; ICSC 273; JMPR 1986c
Ferimzone [ISO]	89269-64-7			S	F	4	725	
Fipronil	120068-37-3	2588		S	I	3	92	JMPR 1998b, 2001; *ICSC 1503*
Fluchloralin [ISO]	33245-39-5			S	H	4	1550	
Flufenacet [ISO]	142459-58-3			S	H	4	600	May cause skin sensitization
Fluoroglycofen	77501-60-1			S	H	4	1550	
Flurprimidol [ISO]	56425-91-3			S	PGR	4	709	
Flusilazole	85509-19-9			S	F	4	*672*	JMPR 1996b, *2009b*
Flutriafol [ISO]	76674-21-0			S	F,FST	4	1140	
Fluxofenim [ISO]	88485-37-4			oil	H	4	670	
Fomesafen [ISO]	72178-02-0		OC	S	H	4	1250	
Fuberidazole [ISO]	3878-19-1			S	F	4	336	
Furalaxyl [ISO]	57646-30-7			S	F	4	940	
Gamma-HCH [ISO], Lindane	58-89-9	2761	OC	S	I	3	88	*ICSC 53*; JMPR 2003b; See note 3
Glufosinate [ISO]	53369-07-6			S	H	4	1625	JMPR 2000
Guazatine	108173-90-6			S	FST	3	230	LD_{50} value refers to triacetate; JMPR 1998b
Haloxyfop	69806-34-4			S	H	4	*300*	JMPR 1996b, *2008 (includes Haloxyfop-R and esters)*
HCH [ISO]	608-73-1	2761	OC	S	I	3	100	See notes 3, 4 and 5; EHC 123; IARC 5, 20, 42; ICSC 487; JMPR 1974
Hexazinone [ISO]	51235-04-2			S	H	4	1690	
Hydramethylnon	67485-29-4			S	I	4	1200	
Imazalil [ISO]	35554-44-0	2588		S	F	3	*227*	ICSC 1303; JMPR 2001, 2002, *2006b*
Imidacloprid [ISO]	138261-41-3			S	I	4	450	JMPR 2002; *ICSC 1501*

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Iminoctadine [ISO]	13516-27-3			S	F	3	300	Eye irritant
Indoxacarb [ISO]	*173584-44-6*			*S*	*I*	*3*	*268*	*JMPR 2006b; LD_{50} applies to 3:1 mixture of isomers in commercial use*
Ioxynil [ISO]	1689-83-4	2588		S	H	3	110	ICSC 900
Ioxynil octanoate [(ISO)]	3861-47-0			S	H	4	390	
Iprobenfos	26087-47-8			S	F	4	600	
Isoprocarb [ISO]	2631-40-5	2757	C	S	I	4	403	
Isoprothiolane [ISO]	50512-35-1			S	F	4	1190	
Isoproturon [ISO]	34123-59-6			S	H	4	1800	
Isouron [ISO]	55861-78-4			S	H	4	630	
Lambda-cyhalothrin	2164-08-1	3349	PY	S	I	3	c56	See note 9, p. 8; EHC 142; HSG 38; *JMPR 2009b; ICSC 859*
MCPA [ISO]	94-74-6		PAA	S	H	4	700	IARC 30, 41; ICSC 54
MCPA-thioethyl [ISO]	25319-90-8		PAA	S	H	4	790	
MCPB [ISO]	94-81-5			S	H	4	680	
Mecoprop [ISO]	7085-19-0			S	H	4	930	ICSC 55
Mecoprop-P [ISO]	16484-77-8			S	H	4	1050	
Mefluidide [ISO]	53780-34-0			S	H	4	1920	
Mepiquat [ISO]	15302-91-7			S	PGR	4	1490	
Mercurous chloride [C]	10112-91-1	2025	HG	S	F	3	210	See note 3; ICSC 984; *CICAD 50*
Metalaxyl [ISO]	57837-19-1			S	F	4	670	JMPR 1983, 2003b
Metaldehyde [ISO]	108-62-3			S	M	3	227	DS 93
Metamitron [ISO]	41394-05-2			S	H	4	1183	*ICSC 1361*
Metam-sodium [(ISO)]	137-42-8	2771		S	F-S	3	285	
Metconazole [ISO]	125116-23-6			S	F	4	660	
Methacrifos [ISO]	62610-77-9		OP	L	I	4	678	JMPR 1991

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Methasulfocarb [ISO]	66952-49-6	2757		S	F	3	112	
Methylarsonic acid [ISO]	124-58-3		AS	S	H	4	1800	ICSC 755; EHC 224
Methyl isothiocyanate [ISO]	556-61-6	2588		S	F-S	3	72	Skin and eye irritant; see note 6
Metolcarb [ISO]	1129-41-5		C	S	I	3	268	
Metribuzin [ISO]	21087-64-9			S	H	4	322	*ICSC 516*
Molinate [ISO]	2212-67-1		TC	L	H	4	720	
Myclobutanil	88671-89-0			S	F	4	1600	JMPR 1993
Nabam [ISO]	142-59-6	2771		S	F	4	395	Goitrogenic in rats
Naled [ISO]	300-76-5	3018	OP	L	I	4	430	DS 39; ICSC 925
2-Napthyloxyacetic acid [ISO]	120-23-0			S	PGR	4	600	
Nitrapyrin [ISO]	1929-82-4			S	B-S	4	1072	*ICSC 1658*
Nuarimol [ISO]	63284-71-9			S	F	4	1250	
Octhilinone [ISO]	26530-20-1			S	F	4	1470	
Oxadixyl	77732-09-3			S	F	4	1860	
Paclobutrazol [ISO]	76738-62-0			S	PGR	4	1300	JMPR 1989
Paraquat [ISO]	1910-42-5	2781	BP	S	H	3	150	See note 7; DS 4; EHC 39; HSG 51; ICSC 5; JMPR 1987a, 2004
Pebulate [ISO]	1114-71-2		TC	L	H	4	1120	
Pendimethalin [ISO]	40487-42-1			S	H	4	1050	
Permethrin [ISO]	52645-53-1	3352	PY	L	I	4	c500	See note 9, p. 8; DS 51; EHC 94; HSG 33; IARC 53; ICSC 312; JMPR 2000
Phenthoate [ISO]	2597-03-7	3018	OP	L	I	4	c400	DS 48; JMPR 1985c
Phosalone [ISO]	2310-17-0	2783	OP	S	I	3	120	ICSC 797; JMPR 1998b, 2002
Phosmet [ISO]	732-11-6	2783	OP	S	I,AC	3	113	ICSC 543; JMPR 1999, 2004
Phoxim [ISO]	14816-18-3		OP	L	I	4	D1975	DS 31; JECFA 2000a
Piperophos [ISO]	24151-93-7	3018	OP	oil	H	4	324	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Pirimicarb [ISO]	23103-98-2	2757	C	S	AP	3	147	JMPR 1983, 2005
Pirimiphos-methyl [ISO]	29232-93-7		OP	L	I	4	*1667*	DS 49; JMPR 1993, *2008*
Prallethrin [ISO]	23031-36-9	3352	PY	oil	I	4	460	
Prochloraz [ISO]	67747-09-5			S	F	4	1600	JMPR 1985a
Profenofos [ISO]	41198-08-7	3018	OP	L	I	4	358	JMPR 1991, 2008
Propachlor [ISO]	1918-16-7			S	H	4	1500	DS 78; EHC 147; HSG 77; JMPR 2002
Propanil [ISO]	709-98-8			S	H	4	c1400	ICSC 552
Propiconazole [ISO]	60207-90-1			L	F	4	1520	JMPR 1988, 2005
Propoxur [ISO]	114-26-1	2757	C	S	I	3	95	DS 25; ICSC 191; JMPR 1990
Prosulfocarb [ISO]	52888-80-9		TC	L	H	4	1820	
Prothiofos [ISO]	34643-46-4		OP	L	I	4	925	
Pyraclofos [ISO]	77458-01-6	3018	OP	L	I	3	237	
Pyrazophos [ISO]	13457-18-6	2784		S	F	4	435	JMPR 1993
Pyrazoxyfen [ISO]	71561-11-0			S	H	4	1644	
Pyrethrins [C]	8003-34-7			L	I	4	500-1000	See note 8; DS 11; JMPR 2000, 2004; *ICSC 1475*
Pyridaben [ISO]	96489-71-3			S	AC	4	820	
Pyridaphenthion	119-12-0		OP	S	I	4	769	
Pyroquilon [ISO]	57369-32-1			S	F	4	320	
Quinalphos [ISO]	13593-03-8	2783	OP	S	I	3	62	
Quinoclamine [ISO]	2797-51-5			S	H	4	1360	
Quizalofop	76578-12-6			S	H	4	1670	
Quizalofop-p-tefuryl [ISO]	119738-06-6			L	H	4	1012	
Rotenone [C]	83-79-4	2588		S	I	3	132-1500	See note 9; HSG 73; ICSC 944
Simetryn [ISO]	1014-70-6		T	S	H	4	1830	
Sodium chlorate [ISO]	7775-09-9	1495		S	H	4	1200	ICSC 1117

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Spiroxamine [ISO]	118134-30-8			L	F	4	500	Dermal LD_{50} 1068 mg/kg; may cause skin sensitisation
Sulfluramid [ISO]	4151-50-2			S	I	4	543	
2,3,6-TBA [ISO]	50-31-7			S	H	4	1500	
TCA [ISO] (acid)	76-03-9	1839		S		4	400	See note 5 to Table 4, p. 38; ICSC 586
Tebuconazole [ISO]	107534-96-3			S	F	4	1700	JMPR 1995b
Tebufenpyrad [ISO]	119168-77-3			S	MT	4	595	
Tebuthiuron [ISO]	34014-18-1			S	H	4	644	
Terbumeton [ISO]	33693-04-8		T	S	H	4	483	
Tetraconazole [ISO]	112281-77-3			Oil	F	4	1031	
Thiacloprid	111988-49-9		S	I		4	*396*	*JMPR 2008*
Thiobencarb [ISO]	28249-77-6		TC	L	H	4	1300	
Thiocyclam [ISO]	31895-22-4			S	I	4	310	
Thiodicarb [ISO]	59669-26-0	2757	C	S	I	3	66	JMPR 2001
Thiram [ISO]	137-26-8			S	F	4	560	DS 71; EHC 78; IARC 12, 53; ICSC 757; JMPR 1993; See note 3
Tralkoxydim [ISO]	87820-88-0			S	H	4	934	
Tralomethrin	66841-25-6	3349	PY	S	I	3	c85	
Triadimefon [ISO]	43121-43-3			S	F	4	602	JMPR 1986b, 2005
Triadimenol [ISO]	55219-65-3			S	FST	4	900	JMPR 1990, 2005
Triazamate [ISO]	112143-82-5	2588		S	AP	3	50-100	
Trichlorfon [ISO]	52-68-6		OP	S	I	3	250	DS 27; EHC 132; HSG 66; IARC 30, Suppl 7; ICSC 585; JMPR 1979; JECFA 2000b, 2003
Triclopyr [ISO]	55335-06-3			S	H	4	710	
Tricyclazole [ISO]	41814-78-2			S	F	4	305	
Tridemorph [ISO]	81412-43-3			Oil	F	4	650	
Triflumizole	99387-89-0			S	F	4	695	ICSC 1252

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Uniconazole [ISO]	83657-22-1			S	PGR	4	1790	
XMC	2655-14-3		C	S	I	4	542	
Xylylcarb	2425-10-7		C	S	I	4	380	
Ziram [ISO]	137-30-4			S	F	4	1400	Irritant to skin; DS 73; EHC 78; IARC 12, 53; ICSC 348; JMPR 1997b

EHC = Environmental Health Criteria Monograph; DS= Pesticide Data Sheet; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JECFA = Evaluation by the Joint FAO/WHO Expert Committee on Food Additives; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

Notes to Class II

1. Alachlor was previously classified as a Class Ia pesticide due to its carcinogenicity in rats. However mechanistic studies have indicated that tumors are induced by a mechanism not relevant to humans.
2. Bioallethrin, esbiothrin, esbiol, and esdepalléthrine are members of a series; their toxicity varies considerably within this series, according to concentrations of isomers.
3. The international trade of chlordane, DDT, Gamma-HCH (lindane), HCH, mercury compounds and thiram is regulated by the Rotterdam convention on Prior Informed Consent (see http://www.pic.int/), which entered into force on 24 February 2004. See Table 7, p. 51.
4. The production and use of chlordane, DDT, *Gamma-HCH (lindane) and HCH (specifically alpha-HCH and beta-HCH)* are strictly limited by the Stockholm convention on persistent organic pollutants, which entered into force on 17 May, 2004 *and has subsequently been amended*. See http://www.pops.int/.
5. HCH: The LD_{50} varies according to the mixture of isomers. The value shown has been chosen, and the technical product placed in Class II, as a result of the cumulative properties of the beta isomer.
6. The melting point of methyl isothiocyanate (S) is 35°C.
7. Paraquat has serious delayed effects if absorbed. It is of relatively low hazard in normal use but may be fatal if the concentrated product is taken by mouth or spread on the skin.
8. Mixture of compounds present in *Pyrethrum cineraefolium* and other flowers.
9. Compounds from roots of *Derris* and *Lonchocarpus* spp.

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See Pages 7 & 8, and the Annex

Table 4. Slightly hazardous (Class III) technical grade active ingredients in pesticides

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Acetochlor [ISO]	34256-82-1			L	H	5	2950	
Alloxydim	55634-91-8			S	H	5	2260	
Ammonium sulfamate	7773-06-0			S	H	5	3900	
Ancymidol [ISO]	12771-68-5			S	PGR	5	4500	
Asulam [ISO]	3337-71-1			S	H	5	4000	
Atrazine [ISO]	1912-24-9		T	S	H	4	c2000	DS 82; HSG 47; IARC 53; ICSC 99
Bacillus thuringiensis (Bt)	68038-71-1			S	I	5	>4000	EHC 217
Benalaxyl [ISO]	71626-11-4			S	F	5	4200	JMPR 1988, 2006
Benazolin [ISO]	3813-05-6			S	H	5	3200	Irritant to skin and eyes
Benfuresate	68505-69-1			S	H	5	2031	
Biphenyl	92-52-4			S	F	5	3280	ICSC 106
Bispyribac	125401-75-4			S	H	5	2635	
Borax [ISO]	1303-96-4			S	F	5	4500	ICSC 567
Bupirimate [ISO]	41483-43-6			S	F	5	c4000	
Buprofezin [ISO]	69327-76-0			S	I	5	2200	JMPR 1992
Butachlor	23184-66-9			L	H	5	3300	
Butylate [ISO]	2008-41-5		TC	L	F	5	>4000	
Carboxin [ISO]	5234-68-4			S	FST	5	3820	
Chinomethionat [ISO]	2439-01-2			S	AC,F	5	2500	JMPR 1988
Chloridazon [ISO]	1698-60-8			S	H	5	2420	
Chlorimuron	99283-00-8			S	H	5	4102	
Chlorpyrifos methyl [ISO]	5598-13-0		OP	S	I	5	>3000	DS 33; JMPR 1993
Chlorthal-dimethyl [ISO]	1861-32-1			S	H	5	>3000	
Chlozolinate	84332-86-5			S	F	5	>4000	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Cinmethylin	87818-31-3			L	H	5	3960	
Clofentezine [ISO]	74115-24-5			S	AC	5	*>3200*	JMPR 1987a, *2006b*
Clopyralid	57754-85-5			S	H	5	4300	Severe irritant to eyes; *ICSC 443*
Cycloate [ISO]	1134-23-2		TC	L	H	4	>2000	
Cycloxydim	101205-02-1			S	H	5	3900	JMPR 1993
Cyromazine	66215-27-8			S	L	5	3300	JMPR 1991
Diafenthiuron [ISO]	80060-09-9			S	AC	5	2068	
Dichlobenil [ISO]	1194-65-6			S	H	5	3160	ICSC 867
Dichlormid	37764-25-3			L	H	5	2080	
Dicloran	99-30-9			S	F	5	4000	ICSC 871; JMPR 1999
Diethyltoluamide [ISO]	134-62-3			L	RP (insect)	4	c2000	DS 80
Diflubenzuron	35367-38-5			S	L	5	>4640	DS 77, EHC 184; HSG 99; JMPR 2002
Diflufenican [ISO]	83164-33-4			S	H	4	>2000	
Dimefuron [ISO]	34205-21-5			S	H	4	>2000	
Dimethametryn [ISO]	22936-75-0		T	L	H	5	3000	
Dimethirimol	5221-53-4			S	F	5	2350	
Dimethomorph [ISO]	110488-70-5			S	F	5	*3500*	*JMPR 2009b*
Dinitramine [ISO]	29091-05-2			S	H	5	3000	
Diuron [ISO]	330-54-1			S	H	5	3400	
Dodemorph [ISO]	1593-77-7			L	H	5	4500	
Empenthrin [(1R) isomers] [ISO]	54406-48-3		PY	Oil	I	5	>2280	
Esprocarb [ISO]	85785-20-2		TC	L	H	4	>2000	Skin and eye irritant
Ethephon	16672-87-0			S	PGR	5	>4000	JMPR 2004; 2003b
Etridiazole [ISO]	2593-15-9			L	F	4	2000	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Fenarimol [ISO]	60168-88-9			S	F	5	2500	JMPR 1996b
Fenbuconazole	114369-43-6			S	F	4	>2000	JMPR 1998
Fenbutatin oxide [ISO]	13356-08-6		OT	S	MT	5	2630	EHC 15; JMPR 1993
Fenpropimorph	67564-91-4			oil	F	5	3515	JMPR 1995b, 2002, 2005
Flamprop-M	90134-59-1			S	F	5	>3000	
Fluazifop-p-butyl [ISO]	83066-88-0			L	H	5	2451	
Flufenoxuron	101463-69-8			S	I	5	>3000	
Flurochloridone	61213-25-0			S	H	5	4000	
tau-Fluvalinate	102851-06-9		PY	oil	I	5	>3000	Skin and eye irritant
Fosamine [ISO]	25954-13-6		OP	S	H	5	2400	
Glyphosate [ISO]	1071-83-6			S	H	5	4230	EHC 159, DS 91; ICSC 160; JMPR 1987a
Halofenozide	112226-61-6			S	I	5	2850	
Hexaconazole	79983-71-4			S	F	5	2180	JMPR 1991
Hymexazol	10004-44-1			S	FST	5	3900	
Iprodione [ISO]	36734-19-7			S	F	5	3500	JMPR 1996b
Linuron [ISO]	330-55-2			S	H	5	4000	ICSC 1300
Malathion [ISO]	121-75-5	3082	OP	L	I	5	c2100	See note 1; DS 29; IARC 30; ICSC 172; JMPR 1998b, 2004
Metazachlor	67129-08-2			S	H	5	2150	
Methabenzthiazuron [ISO]	18691-97-9			S	H	5	>2500	
Methyldymron	42609-73-4			S	H	5	3948	
Metobromuron [ISO]	3060-89-7			S	H	5	2500	
Metolachlor [ISO]	51218-45-2			L	H	5	2780	*ICSC 1360*
Metoxuron	19937-59-8			S	H	5	>3200	
Monolinuron	1746-81-2			S	H	5	2250	ICSC 1273

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
1-Naphthylacetic acid	86-87-3			S	PGR	5	c3000	
N-octylbicycloheptene dicarboximide [C]	113-48-4			L	SY	5	2800	
Ofurace	58810-48-3			S	F	5	2600	
Oxycarboxin [ISO]	5259-88-1			S	F	4	2000	
Penconazole	66246-88-6			S	F	5	2120	JMPR 1993
2-Phenylphenol [C]	90-43-7			S	F	5	2480	ICSC 669; IARC 30; JMPR 2000
Pimaricin	7681-93-8			S	F	5	2730	See note 2
Probenazole	27605-76-1			S	F	5	2030	
Prometon [ISO]	1610-18-0		T	S	H	5	2980	
Prometryn [ISO]	7287-19-6		T	S	H	5	3150	
Propargite [ISO]	2312-35-8			L	AC	5	2200	JMPR 2000
Pyridate [ISO]	55512-33-9			S	H	5	c2000	
Pyrifenox [ISO]	88283-41-4			L	F	4	2900	
Pyrimethanil [ISO]	53112-28-0			S	F	5	4150	*JMPR 2009b*
Pyrithiobac sodium [ISO]	123343-16-8			S	H	5	3200	
Quinclorac	84087-01-4			S	H	5	2680	
Resmethrin [ISO]	10453-86-8		PY	S	I	4	2000	See note 3; EHC 92, DS 83, HSG 25; ICSC 324
Sethoxydim [ISO]	74051-80-2			L	H	5	3200	
Spinosad [ISO]	168316-95-8			S	I	5	3738	For Spinosyn A and D, CAS numbers are 131929-60-7 and 131929-63-0; JMPR 2002; *ICSC 1502*
Spirotetramat [ISO]	203313-25-1			*S*	*I*	4	*>2000*	*JMPR 2009a*
Sulphur	7704-34-9	1350		S	F,I	5	>3000	Skin and mucous membrane irritant. See note 4; ICSC 1166
TCA (sodium salt) [ISO]	650-51-1			S	H	5	3200	*ICSC 1139*; Irritant to skin and eyes: see note 5
Temephos [ISO]	3383-96-8		OP	L	I	5	*4000*	DS 8; ICSC 199; *JMPR 2008*

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Terbuthylazine [ISO]	5915-41-3		T	S	H	5	2160	
Terbutryn [ISO]	886-50-0		T	S	H	5	2400	
Tetrachlorvinphos [ISO]	22248-79-9		OP	S	I	5	4000	
Thiabendazole [ISO]	148-79-8			S	F	5	3330	JECFA 1997, 2002
Thidiazuron	51707-55-2			S	PGR	5	>4000	
Tri-allate [ISO]	2303-17-5		TC	L	H	5	2165	HSG 89; ICSC 201
Trietazine [ISO]	1912-26-1		T	S	H	5	2830	ICSC 202
Triticonazole [ISO]	131983-72-7			S	F	4	>2000	
Undecan-2-one [C]	112-12-9			Oil	RP, (dogs,cats)	5	2500	

EHC = Environmental Health Criteria Monograph; DS = Pesticide Data Sheet; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JECFA = Evaluation by the Joint FAO/WHO Expert Committee on Food Additives; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

Notes to Class III

1. Malathion: LD_{50} value can vary according to impurities. This value has been adopted for classification purposes and is that of a technical product conforming to WHO specifications.
2. Pimaricin: antibiotic, identical with tennecetin and natamycin.
3. Resmethrin is a mixture of isomers, the trans isomer (70-80%) also being known as bioresmethrin and the cis isomer (20-30%) as cismethrin. Bioresmethrin alone is of much lower toxicity (oral LD_{50} >7000 mg/kg) and is the subject of DS 34. It appears in Table 5.
4. Sulphur dust can spontaneously ignite unless diluted about 50% with inert material.
5. TCA: The data shown refer to sodium trichloroacetic acid. In many countries, the same term (TCA) refers to the free acid (now accepted by ISO): this is a solid with an oral LD_{50} of 400 mg/kg bw and if used as a pesticide would be placed in Class II. It is highly corrosive to skin.

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See Pages 7 & 8, and the Annex

Table 5. Technical grade active ingredients of pesticides unlikely to present acute hazard in normal use

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Aclonifen	74070-46-5			S	H	5	>5000	
Acrinathrin [ISO]	101007-06-1		PY	S	MT	5	>5000	
Aminopyralid [ISO]	*150114-71-9*			*S*	*H*	5	*>5000*	*JMPR 2009b*
Amitrole [ISO]	61-82-5			S	H	5	5000	EHC 158, DS 79; HSG 85; IARC 79; ICSC 631; JMPR 1998b
Anthraquinone	84-65-1			S	RP (birds)	5	>5000	*ICSC 1605*
Azimsulfuron [ISO]	120162-55-2			S	H	5	>5000	
Azoxystrobin [ISO]	131860-33-8			S	F	5	>5000	*JMPR 2009a*
Benfluralin [ISO]	1861-40-1			S	H	5	>10000	
Benomyl [ISO]	17804-35-2			S	F	5	>10000	EHC 148, DS 87; HSG 81; ICSC 382; JMPR 1996b. *See note 1*
Benoxacor [ISO]	98730-04-2			S	H	5	>5000	This molecule is not an active substance as such but is a “safener”
Bensulfuron-methyl	83055-99-6			S	H	5	>5000	
Bifenazate [ISO]	*149877-41-8*			*S*	*AC*	5	*>5000*	*JMPR 2008*
Bifenox [ISO]	42576-02-3			S	H	5	>6400	
Bioresmethrin [ISO]	28434-01-7		PY	L	I	5	>7000	DS 34; EHC 92; HSG 25; ICSC 229; JMPR 1992
Bitertanol	55179-31-2			S	F	5	>5000	JMPR 1999
Boscalid [ISO]	*188425-85-6*			*S*	*F*	5	*>5000*	*JMPR 2008*
Bromacil [ISO]	314-40-9			S	H	5	5200	*ICSC 1448*
Bromobutide	74712-19-9			S	H	5	>5000	
Bromopropylate [ISO]	18181-80-1			S	AC	5	>5000	JMPR 1994
Captan [ISO]	133-06-2			S	F	5	9000	Irritant to skin; DS 9; HSG 50; IARC 30, Suppl 7; ICSC 120; JMPR 1996b, 2005

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Carbendazim [ISO]	10605-21-7			S	F	5	>10000	DS 89; EHC 149; HSG 82; ICSC 1277; JMPR 1996b, *2006b*
Carbetamide [ISO]	16118-49-3		C	S	H	5	>10000	
Carpropamid [ISO]	104030-54-8			L	F	5	>5000	
Chloransulam methyl	14750-35-4			S	H	5	>5000	
Chlorantraniliprole [ISO]	*500008-45-7*			*S*	*I*	5	*>5000*	*JMPR 2009a*
Chlorfluazuron	71422-67-8			S	IGR	5	8500	
Chlorothalonil [ISO]	1897-45-6			S	F	5	>10000	EHC 183; HSG 98; IARC 30; ICSC 134; JMPR 1993
Chlorotoluron [ISO]	15545-48-9			S	H	5	>10000	*ICSC 1327*
Chlorpropham [ISO]	101-21-3		C	S	PGR	5	>5000	IARC 12; JMPR 2001; *ICSC 1500*
Chlorsulfuron	64902-72-3			S	H	5	5545	
Cinosulfuron [ISO]	94593-91-6			S	H	5	>5000	
Clomeprop	84496-56-0			S	H	5	>5000	
Cloxyfonac	32791-87-0		PAA	S	PGR	5	>5000	
Cryolite [C]	15096-52-3			S	I	5	>10000	
Cycloprothrin	63935-38-6		PY	L	I	5	>5000	
Cyclosulfamuron [ISO(*)]	136849-15-5			S	H	5	>5000	
Cyhalofop [ISO]	122008-85-9			S	H	5	>5000	
Daimuron	42609-52-9			S	H	5	>5000	
Dalapon	75-99-0			S	H	5	9330	
Daminozide [ISO]	1596-84-5			S	H	5	8400	JMPR 1993
Desmedipham [ISO]	13684-56-5			S	H	5	>9600	
Dichlofluanid [ISO]	1085-98-9			S	F	5	>5000	JMPR 1985a
Diclomezine	62865-36-5			S	F	5	>10000	
Diclosulam [ISO]	145701-21-9			S	H	5	>5000	
Diethofencarb	87130-20-9			S	F	5	>5000	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Dikegulac [ISO]	18467-77-1			S	PGR	5	>10000	
Dimethomorph [ISO]	110488-70-5			S	F	5	>5000	
Dimethyl phthalate [C]	131-11-3			L	RP (insect)	5	8200	ICSC 261
Dipropyl isocinchomerate [C]	3737-22-2			L	RP (fly)	5	5230	
Dithiopyr [ISO]	97886-45-8			S	H	5	>5000	
Ethalfluralin [ISO]	55283-68-6			S	H	5	>10000	
Ethirimol [ISO]	23947-60-6			S	FST	5	6340	
Ethofumesate [ISO]	26225-79-6			S	H	5	>6400	
Ethyl butylacetylaminopropionate	52304-36-6			L	RP (insect)	5	>5000	
Etofenprox	80844-07-1			S	I	5	>10000	JMPR 1994
Famoxadone [ISO(*)]	131807-57-3			S	F	5	>5000	JMPR 2004
Fenchlorazole [ISO]	103112-35-2			S	H	5	>5000	
Fenclorim	3740-92-9			S	H	5	>5000	
Fenfuram [ISO]	24691-80-3			S	FST	5	>10000	
Fenhexamid [ISO]	126833-17-8			S	F	5	>5000	*JMPR 2006b*
Fenoxycarb	79127-80-3		C	S	I	5	>10000	
Fenpiclonil	74738-17-3			S	FST	5	>5000	
Ferbam [ISO]	14484-64-1			S	F	5	>10000	DS 94; EHC 78; IARC 12, 42; ICSC 792; JMPR 1997b
Florasulam	145701-23-1			S	H	5	>5000	
Flucarbazone-sodium	181274-17-9			S	H	5	> 5000	
Flucycloxuron [ISO]	94050-52-9			S	AC	5	>5000	
Fludioxonil [ISO]	*131341-86-1*			*S*	*F*	5	>5000	*JMPR 2006a*
Flumetralin	62924-70-3			S	PGR	5	>5000	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Flumetsulam [ISO]	98967-40-9			S	H	5	>5000	
Fluometuron [ISO]	2164-17-2			S	H	5	>8000	
Flupropanate	756-09-2			S	H	5	>10000	
Flupyrsulfuron [ISO]	144740-54-5			S	H	5	>5000	
Flurenol [ISO]	467-69-6			S	PGR	5	>5000	
Fluridone [ISO]	59756-60-4			S	H	5	>10000	
Fluroxypyr	69377-81-7			S	H	5	>5000	
Fluthiacet	149253-65-6			S	H	5	>5000	
Flutolanil	66332-96-5			S	F	5	>10000	ICSC 1265; JMPR 2003b
Folpet	133-07-3			S	F	5	>10000	HSG 72; ICSC 156; JMPR 1996b
Fosetyl	15845-66-2			S	F	5	5800	
Gibberellic acid	77-06-5			S	PGR	5	>10000	
Hexaflumuron [ISO]	86479-06-3			S	I	5	>5000	ICSC 1266
Hexythiazox	78587-05-0			S	AC	5	>5000	JMPR 1992, *2009a*
Hydroprene [ISO]	41205-09-8			L	IGR	5	>10000	
2-Hydroxyethyl octyl sulphide [C]	3547-33-9			L	RP (insect)	5	8530	
Imazamethabenzmethyl [(ISO)]	81405-85-8			S	H	5	>5000	
Imazapyr	81334-34-1			S	H	5	>5000	Irritant to eyes
Imazaquin	81335-37-7			S	H	5	>5000	
Imazethapyr	81335-77-5			S	H	5	>5000	
Imibenconazole [ISO]	86598-92-7			S	F	5	>5000	
Inabenfide	82211-24-3			S	PGR	5	>10000	
Iprovalicarb	140923-17-7			S	F	5	>5000	
Isoxaben	82558-50-7			S	H	5	>10000	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Kasugamycin	19408-46-9			S	F	5	>10000	
Lenacil [ISO]	2164-08-1			S	H	5	>10000	
Maleic hydrazide [C]	123-33-1			S	PGR	5	6950	IARC 4, 42; JMPR 1997b CAS10071-13-3
Mancozeb	8018-01-7			S	F	5	>8000	Irritant to skin on multiple exposure; DS 94; EHC 78; ICSC 754; JMPR 1994
Mandipropamid [ISO]	*374726-62-2*			*S*	*F*	5	*>5000*	*JMPR 2009a*
Maneb [ISO]	12427-38-2			S	F	5	6750	Irritant to skin on multiple exposure; DS 94; EHC 78; ICSC 173; JMPR 1994
Mefenacet	73250-68-7			S	H	5	>5000	
Mepanipyrim [ISO]	110235-47-7			S	F	5	>5000	
Mepronil [ISO]	55814-41-0			S	F	5	>10000	
Methoprene [ISO]	40596-69-8			L	IGR	5	>10000	DS 47; JMPR 1987b, 2002
Methoxychlor [ISO]	72-43-5		OC	S	I	5	6000	DS 28; IARC 5, 20; ICSC 1306; JMPR 1978
Methozyfenozide	161050-58-4			S	I	5	>5000	Dermal LD_{50} > 5000; JMPR 2004
Metiram	9006-42-2			S	F	5	>10000	JMPR 1994
Metosulam	139528-85-1			S	H	5	>5000	
Metsulfuron methyl	74223-64-6			S	H	5	>5000	
2-(1-Naphthyl) acetamide	86-86-2			S	PGR	5	6400	
Napropamide	15299-99-7			S	H	5	5000	
Naptalam	132-66-1			S	PGR	5	8200	
Neburon [ISO]	555-37-3			S	H	5	>10000	
Niclosamide [ISO]	50-65-7			S	M	5	5000	DS 63
Nicosulfuron [ISO]	111991-09-4			S	H	5	>5000	Irritant to eyes
Nitrothal-isopropyl [ISO]	10552-74-6			S	F	5	6400	
Norflurazon [ISO]	27314-13-2			S	H	5	>8000	
Novaluron [ISO]	*116714-46-6*			*S*	*I*	5	*>5000*	*JMPR 2006b*

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Noviflumuron	121451-02-3			S	I	5	>5000	Dermal LD_{50} > 5000
Oryzalin [ISO]	19044-88-3			S	H	5	>10000	
Oxabetrinil	74782-23-3			S	H	5	>5000	
Oxadiazon [ISO]	19666-30-9			S	H	5	>8000	
Oxine-copper [ISO]	10380-28-6		CU	S	F	5	7792	
Oxyfluorfen [ISO]	42874-03-3			S	H	5	>5000	
Pencycuron	66063-05-6			S	F	5	>5000	
Penoxsulam	219714-96-2			S	H	5	>5000	Dermal LD_{50} > 5000
Pentanochlor	2307-68-8			S	H	5	>10000	
Phenmedipham [ISO]	13684-63-4			S	H	5	>8000	
Phenothrin [ISO]	26002-80-2		PY	L	I	5	>5000	DS 85; EHC 96; HSG 32; ICSC 313; JMPR 1989
Phosphorus acid [C]	13598-36-2			L	F	5	>5000	
Phthalide	27355-22-2			S	F	5	>10000	
Picloram [ISO]	1918-02-1			S	H	5	8200	ICSC 1246
Piperonyl butoxide	51-03-6			Oil	SY	5	>7500	IARC 30; JMPR 1996b; *ICSC 1347*
Pretilachlor [ISO]	51218-49-6			L	H	5	6100	
Primisulfuron [ISO]	113036-87-6			S	H	5	>5050	
Procymidone [ISO]	32809-16-8			S	F	5	6800	JMPR 1990, *2009b*
Prodiamine [ISO]	29091-21-2			S	H	5	>5000	
Propamocarb	24579-73-5			S	F	5	8600	JMPR 1987a
Propaquizafop	111479-05-1			S	H	5	>5000	ICSC 1271
Propazine [ISO]	139-40-2		T	S	H	5	>5000	ICSC 697
Propham [ISO]	122-42-9			S	H	5	5000	IARC 12; JMPR 1993
Propineb [ISO]	12071-83-9			S	H	5	8500	DS 94; EHC 78; JMPR 1994
Propyzamide [ISO]	23950-58-5			S	H	5	5620	

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Prothioconazole [ISO]	*178928-70-6*			*S*	*F*	5	*>6200*	*JMPR 2009a*
Pyrazolynate [ISO]	58011-68-0			S	H	5	9550	
Pyrazosulfuron [ISO]	98389-04-9			S	H	5	>5000	
Pyriminobac	136191-56-5			S	H	5	>5000	
Pyriproxyfen [ISO]	95737-68-1			S	I	5	>5000	ICSC 1269; JMPR 2000
Quinmerac [ISO]	90717-03-6			S	H	5	>5000	
Quinoxyfen [ISO]	124495-18-7			S	F	5	>5000	*JMPR 2008*
Quintozene [ISO]	82-68-8			S	F	5	>10000	EHC 41; HSG 23; IARC 5; JMPR 1996b; *ICSC 745*
Rimsulfuron [C]	122931-48-0			S	H	5	>5000	
Siduron [ISO]	1982-49-6			S	H	5	>7500	
Simazine [ISO]	122-34-9		T	S	H	5	>5000	ICSC 699
Spinetoram [ISO]	*187166-40-1*			S	*I*	5	*>5000*	*JMPR 2009a*
Sulfometuron	74223-56-6			S	H	5	>5000	
Tebufenozide	112410-23-8			S	I	5	>5000	Dermal LD50 > 5000; JMPR 1997b, 2004
Tebutam	35256-85-0			Oil	H	5	6210	
Tecnazene [ISO]	117-18-0			S	F	5	>10000	EHC 42; HSG 12; JMPR 1995b
Teflubenzuron	83121-18-0			S	I	5	>5000	JMPR 1995b
Terbacil [ISO]	5902-51-2			S	H	5	>5000	
Tetradifon [ISO]	116-29-0			S	AC	5	>10000	EHC 67; HSG 11; ICSC 747
Tetramethrin [ISO]	7696-12-0		PY	S	O	5	>5000	EHC 98; HSG 31; ICSC 334
Thifensulfuron-methyl	79277-27-3			S	H	5	>5000	
Thifluzamide	130000-40-7			S	F	5	>5000	Dermal LD_{50} > 5000
Thiophanate-methyl [ISO]	23564-05-8			S	F	5	>6000	JMPR 1996b, 1999, *2008*
Tiocarbazil	36756-79-3		TC	L	H	5	10000	
Tolclofos-methyl [ISO]	57018-04-9			S	F-S	5	c5000	JMPR 1995b

Common name	CAS no	UN no	Chem type	Phys state	Main use	GHS	LD_{50} mg/kg	Remarks
Tolylfluanid [ISO]	731-27-1			S	F	5	>5000	JMPR 1989, 2003b
Transfluthrin [ISO]	118712-89-3		PY	S	I	5	>5000	
Triasulfuron	82097-50-5			S	H	5	>5000	
Tribenuron [ISO]	106040-48-6			S	H	5	>5000	
Trifloxystrobin [ISO]	*141517-21-7*			S	F	5	*>5000*	*JMPR 2006a*
Triflumuron	64628-44-0			S	PGR	5	>5000	
Trifluralin [ISO]	1582-09-8			S	H	5	>10000	IARC 53; ICSC 205
Triflusulfuron-methyl [ISO]	126535-15-7			S	H	5	>5000	
Triforine [ISO]	26644-46-2			S	F	5	>6000	JMPR 1998b
Validamycin	37248-47-8			S	F	5	>10000	
Vinclozolin [ISO]	50471-44-8			S	F	5	10000	JMPR 1996b
Zineb [ISO]	12122-67-7			S	F	5	>5000	DS 94; EHC 78; IARC 12; ICSC 350; JMPR 1994
Zoxamide [ISO]	*156052-68-5*			*S*	*F*	5	*>5000*	*JMPR 2009b*

EHC = Environmental Health Criteria Monograph; DS= Pesticide Data Sheet; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

Notes to Table 5

1. The international trade of benomyl is regulated by the Rotterdam convention on Prior Informed Consent (see http://www.pic.int/), which entered into force on 24 February 2004. See Table 7, p. 51.

THE FINAL CLASSIFICATION OF ANY PRODUCT
DEPENDS ON ITS FORMULATION
See Pages 7 & 8, and the Annex

TABLE 6. ACTIVE INGREDIENTS BELIEVED TO BE OBSOLETE OR DISCONTINUED FOR USE AS PESTICIDES

Ingredients discontinued have been identified from the previous edition of this classification, from the Pesticide Manual (Pesticide Manual, 1991, 1994; 1997, 2003), and in some cases from the manufacturer. It is difficult, in some cases, to be sure whether or not all commercial activity in a substance has ceased; some of these materials are known to be still in use for non-agricultural purposes. IPCS will be grateful for details of any materials in this Section, which are still in commercial use. The common name and CAS number are indicated.

Active ingredient	CAS no	Active ingredient	CAS no
Acrylonitrile	107-13-1	Butonate	126-22-7
Aldoxycarb	1646-88-4	Butopyronoxyl	532-34-3
Aldrin[1,2]	309-00-2	Buturon	3766-60-7
Allidochlor	93-71-0	Calcium cyanamide	156-62-7
Allyxycarb	6392-46-7	Camphechlor[1,2]	8001-35-2
Amidithion	919-76-6	Carbamorph	31848-11-0
Aminocarb	2032-59-9	Carbanolate	671-04-5
Anilazine	101-05-3	Carbon disulfide	75-15-0
ANTU	86-88-4	Carbophenothion	786-19-6
Aramite	140-57-8	Chlomethoxyfen	32861-85-1
Arsenous oxide	1327-53-3	Chloramben	133-90-4
Athidathion	19691-80-6	Chloraniformethan	20856-57-9
Atraton	1610-17-9	Chloranil	118-75-2
Aziprotryne	4658-28-0	Chloranocryl	2164-09-2
Azothoate	5834-96-8	Chlorbenside	103-17-3
Barban	101-27-9	Chlorbufam	1967-16-4
Barium carbonate	513-77-9	Chlorbicyclen	2550-75-6
Benodanil	15310-01-7	Chlorbormuron	13360-45-7
Benquinox	495-73-8	Chlordecone	143-50-0
Benzoximate	29104-30-1	Chlordimeform[1]	6164-98-3
Benzoylprop-ethyl	33878-50-1	Chlorfenac	85-34-7
Benzthiazuron	1929-88-0	Chlorfenethol	80-06-8
Binapacryl[1]	485-31-4	Chlorfenprop-methyl	14437-17-3
Bis(tributyltin) oxide	56-35-9	Chlorfenson	80-33-1
Bisthiosemi	39603-48-0	Chlorfensulfide	22274-74-0
Bromocyclen	1715-40-8	Chlorflurenol	2536-31-4
Bromofenoxim	13181-17-4	Chlormebuform	37407-77-5
Bromophos	2104-96-3	Chlormethiuron	28217-97-2
Bromophos-ethyl	4824-78-6	Chlornitrofen	1836-77-7
Bufencarb	8065-36-9	Chlorobenzilate[1]	510-15-6
Butacarb	2655-19-8	Chloroneb	2675-77-6
Butam	35256-85-0	Chloropropylate	5836-10-2
Butenachlor	87310-56-3	Chloroxuron	1982-47-4
Buthidazole	55511-98-3	Chlorquinox	3495-42-9
Buthiobate	51308-54-4	Chlorphoxim	14816-20-7

TABLE 6. ACTIVE INGREDIENTS BELIEVED TO BE OBSOLETE OR DISCONTINUED FOR USE AS PESTICIDES, continued

Active ingredient	CAS no
Chlorthiamid	1918-13-4
Chlorthiophos	21923-23-9
Cloethocarb	51487-69-5
Clofop	26129-32-8
Coumachlor	81-82-3
Crimidine	535-89-7
Credazine	14491-59-9
Crotoxyphos	7700-17-6
Crufomate	299-86-5
Cyanofenphos	13067-93-1
Cyanthoate	3734-95-0
Cycloheximide	66-81-9
Cycluron	2163-69-1
Cyometrinil	63278-33-1
Cypendazole	28559-00-4
Cyprofuram	69581-33-5
Cypromid	2759-71-9
Delachlor	24353-58-0
Demephion-O	682-80-4
Demephion-S	2587-90-8
Demeton-O	298-03-3
Demeton-S	126-75-0
Demeton-S-methylsulphon	17040-19-6
Desmetryn	1014-69-3
Dialifos	10311-84-9
Di-allate	2303-16-4
Diamidafos	1754-58-1
Dibromochloropropane	96-12-8
Dibutyl phthalate	84-74-2
Dibutyl succinate	141-03-7
Dichlofenthion	97-17-6
1,2-Dichloropropane	78-87-5
Dichlozoline	24201-58-9
Diclobutrazol	75736-33-3
Dieldrin[1,2]	60-57-1
Dienochlor	2227-47-0
Diethatyl	38727-55-8
Difenoxuron	14214-32-5
Dimefox	115-26-4
Dimethirimol	*5221-53-4*
Dimetilan	644-64-4
Dimexano	1468-37-7
Dinex	131-89-5
Dinocton	32534-96-6
Dinoseb[1]	88-85-7
Dinoseb acetate[1]	2813-95-8
Dioxabenzophos	3811-49-2
Dioxacarb	6988-21-2
Dioxathion	78-34-2
Dipropetryn	4147-51-7
Disul	149-26-8
Ditalimfos	5131-24-8
Drazoxolon	5707-69-7
Eglinazine	6616-80-4
Endothion	2778-04-3
Endrin[2]	72-20-8
EPBP	3792-59-4
Erbon	136-25-4
ESP (Oxydeprofos)	2674-91-1
Etacelasil	37894-46-5
Etaconazole	60207-93-4
Ethidimuron	30043-49-3
Ethiolate	2941-55-1
Ethirimol	*23947-60-6*
Ethoate-methyl	116-01-8
Ethohexadiol	94-96-2
Ethyleneglycolbis (trichloroacetate)	2514-53-6
Etrimfos	38260-54-7
EXD	502-55-6
Fenaminosulf	140-56-7
Fenazaflor	14255-88-0
Fenchlorphos	299-84-3
Fenitropan	65934-95-4
Fenoprop (Silvex)	93-72-1
Fenoxaprop-ethyl	82110-72-3
Fenson	80-38-6
Fensulfothion	115-90-2
Fenthiaprop	95721-12-3
Fenuron	101-42-8
Fenuron-TCA	4482-55-7
Flamprop	58667-63-3
Fluazifop	69335-91-7
Flubenzimine	37893-02-0

TABLE 6. ACTIVE INGREDIENTS BELIEVED TO BE OBSOLETE OR DISCONTINUED FOR USE AS PESTICIDES, continued

Active ingredient	CAS no
Fluenetil	4301-50-2
Fluorodifen	15457-05-3
Fluoromide	13577-71-4
Fluotrimazole	31251-03-3
Fluvalinate	69409-94-5
Fonofos	944-22-9
Formothion	2540-82-1
Fosmethilan	83733-82-8
Fosthietan	21548-32-3
Furconazole-cis	112839-32-4
Furmecyclox	60568-05-0
Glyodin	556-22-9
Glyphosine	2439-99-8
Griseofulvin	126-07-8
Halacrinate	34462-96-9
Haloxydine	2693-61-0
Heptachlor[1,2]	76-44-8
Heptopargil	73886-28-9
Hexachloroacetone	116-16-5
Hexaflurate	17029-22-0
Hydroxyquinoline sulfate	134-31-6
Ipazine	1912-25-0
IPSP	5827-05-4
Isazofos	42509-80-8
Isobenzan	297-78-9
Isobornyl thiocyano acetate	115-31-1
Isocarbamid	30979-48-7
Isocil	314-42-1
Isodrin	465-73-6
Isofenphos	25311-71-1
Isomethiozin	57052-04-7
Isonoruron	28805-78-9
Isopropalin	33820-53-0
Isothioate	36614-38-7
Isoxapyrifop	87757-18-4
Jodfenphos	18181-70-9
Karbutilate	4849-32-5
Kelevan	4234-79-1
Kinoprene	42588-37-4
Leptophos	21609-90-5
Lythidathion	2669-32-1
Malonoben	10537-47-0
Mebenil	7055-03-0
Mecarbinzid	27386-64-7
Mecarphon	29173-31-7
Medinoterb acetate	2487-01-6
Menazon	78-57-9
Mephospholan	950-10-7
Methazole	20354-26-1
Methiuron	21540-35-2
Methoprotryne	841-06-5
Methoxyethylmercury silicate[1]	64491-92-5
Methoxyphenone	41295-28-7
Methoxymethyl mercurychloride[1]	123-88-6
Methylmercury dicyan-diamide[1]	502-39-6
Metobromuron	*3060-89-7*
Metsulfovax	21542-18-6
Mexacarbate	315-18-4
Mipafox	371-86-8
Mirex[2]	2385-85-5
Monalide	7187-36-7
Monuron	150-68-5
Monuron-TCA	140-41-0
Morfamquat	4636-83-3
Myclozolin	54864-61-8
Naphthalene	91-20-3
Naphthalic anhydride	81-84-5
Nitralin	4726-14-1
Nitrilacarb	29672-19-3
Nitrofen	1836-75-5
Norbormide	991-42-4
Noruron	2163-79-3
Oxapyrazon	4489-31-0
Oxydisulfoton	2497-07-6
Parafluron	7159-99-1
Perfluidone	37924-13-3
Phenisopham	57375-63-0
Phenkapton	2275-14-1
Phenobenzuron	3134-12-1

TABLE 6. ACTIVE INGREDIENTS BELIEVED TO BE OBSOLETE OR DISCONTINUED FOR USE AS PESTICIDES, continued

Active ingredient	CAS no
Phenylmercurydimethyl-dithiocarbamate[1]	32407-99-1
Phenylmercury nitrate[1]	8003-05-2
Phosacetim	4104-14-7
Phosdiphen	36519-00-3
Phosfolan	947-02-4
Pindone	83-26-1
Piproctanyl	69309-47-3
Pirimiphos-ethyl	23505-41-1
Potassium cyanate	590-28-3
Profluralin	26399-36-0
Proglinazine	68228-20-6
Promacyl	34264-24-9
Promecarb	2631-37-0
Propaphos	7292-16-2
Propyl isome	83-59-0
Prothiocarb	19622-08-3
Prothoate	2275-18-5
Proxan	108-25-8
Pydanon	22571-07-9
Pyracarbolid	24691-76-7
Pyridinitril	1086-02-8
Quinacetol sulfate	57130-91-3
Quinonamid	27541-88-4
Ryania	8047-13-0
Sabadilla	8051-02-3
Salicylanilide	87-17-2
Schradan	152-16-9
Scilliroside	507-60-8
Secbumeton	26259-45-0
Sesamex	51-14-9
Sodium fluoride	7681-49-4
Sodium hexafluorosilicate	16893-85-9
Sulfallate	95-06-7
Sulfoxide	120-62-7
Sulprofos	35400-43-2
SWEP	1918-18-9
2,4,5-T[1]	93-76-5
TDE	72-54-8
TEPP	107-49-3
Terbucarb	1918-11-2
Tetrasul	2227-13-6
Thiazafluron	25366-23-8
Thicyofen	116170-30-0
Thionazin	297-97-2
Thiophanate	23564-06-9
Thioquinox	93-75-4
Triamiphos	1031-47-6
Triapenthenol	76608-88-3
Triarimol	26766-27-8
Tricamba	2307-49-5
Trichlamide	70193-21-4
Trichloronat	327-98-0
Tridiphane	58138-08-2
Trifenmorph	1420-06-3
Trimethacarb	12407-86-2
Vernolate	1929-77-7

[1] The international trade of aldrin, binapacryl, camphechlor (toxaphene), chlordimeform, chlorobenzilate, dieldrin, dinoseb and dinoseb salts, heptachlor, mercury compounds, and 2,4,5-T is regulated by the Rotterdam convention on Prior Informed Consent (see http://www.pic.int/), which entered into force on 24 February 2004, with subsequent amendments. See Table 7, p. 51.

[2] The use and production of aldrin, camphechlor (toxaphene), *chlordecone*, dieldrin, endrin, heptachlor and mirex is prohibited or severely restricted by the Stockholm convention on persistent organic pollutants, which entered into force on 17 May, 2004, with subsequent amendments. See http://www.pops.int/

Table 7. Pesticides subject to the Rotterdam Convention[1]

Class	Pesticide	CAS number
O	Aldrin[2]	309-00-2
O	Binapacryl	485-31-4
Ia	Captafol	2425-06-1
II	Chlordane[2]	57-74-9
O	Chlordimeform	6164-98-3
O	Chlorobenzilate	510-15-6
II	DDT[2]	50-29-3
	1,2-Dibromoethane (EDB)	106-93-4
O	Dieldrin[2]	60-57-1
O	Dinoseb and dinoseb salts	88-85-7
Ib	DNOC and its salts (such as ammonium salt, potassium salt and sodium salt)	534-52-1; 2980-64-5; 5787-96-2; 2312-76-7
	Ethylene dichloride	107-06-2
	Ethylene oxide	75-21-8
Ib	Fluoroacetamide	640-19-7
II	HCH (mixed isomers)	608-73-1
O	Heptachlor[2]	76-44-8
Ia	Hexachlorobenzene[2]	118-74-1
II	Lindane[2]	58-89-9
	Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds	
Ib	Pentachlorophenol	87-86-5
O	2,4,5-T	93-76-5
O	Camphechlor (Toxaphene)	8001-35-2
	Dustable powder formulations containing a combination of benomyl at or above 7%, carbofuran at above 10%, thiram at or above 15%	17804-35-2; 1563-66-2; 137-26-8
Ib	Methamidophos (soluble liquid formulations of the substance that exceed 600 g active ingredient/L)	10265-92-6
Ia	Methyl-parathion (emulsifiable concentrates (EC) with 19.5%, 40%, 50%, 60% active ingredient and dusts containing 1.5%, 2% and 3% active ingredient	298-00-0
Ib	Monocrotophos (all formulations)	6923-22-4

Ia	Parathion (all formulations – aerosols, dustable powder (DP), emulsifiable concentrate (EC), granules (GR) and wettable powders (WP) of this substance are included, except capsule suspensions (CS)	56-38-2
Ia	Phosphamidon (soluble liquid formulations of the substance that exceed 1000 g active ingredient/L)	13171-21-6 [mixture, (E) & (Z) isomers] 23783-98-4 [(Z)-isomer] 297-99-4 [(E)-isomer]
	Tributyltin compounds, including: tributyltin oxide; tributyltin benzoate; tributyltin chloride; tributyltin fluoride; tributyltin linoleate; tributyltin methacrylate; tributyltin naphthenate	

[1] According to the Rotterdam Convention, export of a chemical can only take place with the prior informed consent of the importing Party. The Prior Informed Consent (PIC) procedure is a means for formally obtaining and disseminating the decisions of importing countries as to whether they wish to receive future shipments of a certain chemical and for ensuring compliance to these decisions by exporting countries. The aim is to promote a shared responsibility between exporting and importing countries in protecting human health and the environment from the harmful effects of such chemicals (further information can be found at: http://www.pic.int/). The Rotterdam Convention (which entered into force on 24 February 2004) built on the voluntary PIC procedure which was initiated by UNEP and FAO in 1989.

[2] The use and production of aldrin, chlordane, DDT, dieldrin, heptachlor, hexachlorobenzene and lindane is prohibited or severely restricted by the Stockholm convention on persistent organic pollutants, which entered into force on 17 May, 2004. See http://www.pops.int/

TABLE 8. GASEOUS OR VOLATILE FUMIGANTS NOT CLASSIFIED UNDER THE WHO RECOMMENDED CLASSIFICATION OF PESTICIDES BY HAZARD

The Classification does not set out any criteria for air concentrations on which classification could be based. Most of these compounds are of high hazard and recommended exposure limits for occupational exposure have been adopted by national authorities in many countries.

Pesticide	CAS number	Remarks
Aluminium phosphide	20859-73-8	DS 46; EHC 73; HSG 28; JMPR 1967
Chloropicrin	76-06-2	JMPR 1965b
1,2-Dibromoethane	106-93-4	EHC 177; IARC 15
1,3-Dichloropropene	542-75-6	EHC 146; HSG 76; IARC 41
Ethylene dichloride	107-06-2	EHC 62, 176; HSG 55; IARC 20
Ethylene oxide	75-21-8	EHC 55; HSG 16; JMPR 1969; IARC 11, 36, 42
Formaldehyde	50-00-0	EHC 89; HSG 57
Hydrogen cyanide	74-90-8	JMPR 1965b
Magnesium phosphide	12057-74-8	EHC 73; HSG 28
Methyl bromide	74-83-9	DS 5; EHC 166; HSG 86; IARC 41, 45; JMPR 1967
Phosphine	7803-51-2	DS 46; EHC 73; HSG 28; JMPR 1967
Sulfuryl fluoride	2699-79-8	*JMPR 2006b*

EHC = Environmental Health Criteria Monograph; DS = Pesticide Data Sheet; HSG = Health and Safety Guide; IARC = IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; ICSC = International Chemical Safety Card; JMPR = Evaluation by the Joint FAO/WHO Meeting on Pesticide Residues.

ANNEX

HOW TO FIND THE HAZARD CLASS OF A FORMULATION

The following tables A and B can be used to find the hazard class of a formulation. These should be used only if toxicity data is not available on the formulation itself; see the note at the top of page 7.

The tables should be used as follows:

Step 1: What is the approved name of the active ingredient in the pesticide? Use the index to find the entry in tables 1-5 of the Guidelines.

Step 2: From the entry in the Guidelines, what is the route of application used for the classification?

If the route is O (oral), use table A of this Annex. The same table is used for solids and liquids.

If the route is D (dermal), use table B of this Annex. The same table is used for solids and liquids.

Step 3: From the entry in the Guidelines, what is the LD_{50} of the active ingredient?

Using the table A or B, selected in Step 2, find the column along the top line which most nearly includes the LD_{50} figure.

Step 4: What is the concentration % of the active ingredient in the formulation?

Using the same table A or B, find the figure in the left hand column which most nearly includes this percentage figure.

Step 5: Find the square where the column selected in Step 3 crosses the line selected in Step 4. The number in this square is the approximate LD_{50} of the formulation.

Step 6: The hazard classes are shown by blocks of squares. The hazard class of the formulation is that of the block in which lies the square selected in Step 5.

These tables can also be used to find the hazard class of mixtures. First see page 7, para. 4 of the Guidelines and select the method to be used to arrive at the LD_{50} of the mixture. For method (b), use the above method from Step 1, using the name of the more or most toxic ingredient. For method (c), pass to Step 4 using the total percentages of all active ingredients in the mixture.

Table A. LD_{50} values and classification of formulations when the route is ORAL

First row = Oral LD_{50} of the active ingredient

First column = Percent concentration of the active ingredient in the formulation

	Class Ia			Class Ib									Class II																				Class III					
	1	3	5	10	15	20	25	30	35	40	45	50	60	80	100	120	140	160	180	200	250	300	350	400	500	600	700	800	900	1000	1500	2000	2500	3000	3500	4000	4500	5000
100	1	3	5	10	15	20	25	30	35	40	45	50	60	80	100	120	140	160	180	200	250	300	350	400	500	600	700	800	900	1000	1500	2000	2500	3000	3500	4000	4500	5000
95	1	3	5	11	16	21	26	32	37	42	47	53	63	84	105	126	147	168	189	211	263	316	368	421	526	632	737	842	947	1053	1579	2105	2632	3158	3684	4211	4737	
90	1	3	6	11	17	22	28	33	39	44	50	56	67	89	111	133	156	178	200	222	278	333	389	444	556	667	778	889	1000	1111	1667	2222	2778	3333	3889	4444	5000	
85	1	4	6	12	18	24	29	35	41	47	53	59	71	94	118	141	165	188	212	235	294	353	412	471	588	706	824	941	1059	1176	1765	2353	2941	3529	4118	4706		
80	1	4	6	13	19	25	31	38	44	50	56	63	75	100	125	150	175	200	225	250	313	375	438	500	625	750	875	1000	1125	1250	1875	2500	3125	3750	4375	5000		
75	1	4	7	13	20	27	33	40	47	53	60	67	80	107	133	160	187	213	240	267	333	400	467	533	667	800	933	1067	1200	1333	2000	2667	3333	4000	4667			
70	1	4	7	14	21	29	36	43	50	57	64	71	86	114	143	171	200	229	257	286	357	429	500	571	714	857	1000	1143	1286	1429	2143	2857	3571	4286	5000			
65	2	5	8	15	23	31	38	46	54	62	69	77	92	123	154	185	215	246	277	308	385	462	538	615	769	923	1077	1231	1385	1538	2308	3077	3846	4615				
60	2	5	8	17	25	33	42	50	58	67	75	83	100	133	167	200	233	267	300	333	417	500	583	667	833	1000	1167	1333	1500	1667	2500	3333	4167	5000				
55	2	5	9	18	27	36	45	55	64	73	82	91	109	145	182	218	255	291	327	364	455	545	636	727	909	1091	1273	1455	1636	1818	2727	3636	4545					
50	2	6	10	20	30	40	50	60	70	80	90	100	120	160	200	240	280	320	360	400	500	600	700	800	1000	1200	1400	1600	1800	2000	3000	4000	5000					
45	2	7	11	22	33	44	56	67	78	89	100	111	133	178	222	267	311	356	400	444	556	667	778	889	1111	1333	1556	1778	2000	2222	3333	4444						
40	3	8	13	25	38	50	63	75	88	100	113	125	150	200	250	300	350	400	450	500	625	750	875	1000	1250	1500	1750	2000	2250	2500	3750	5000						
35	3	9	14	29	43	57	71	86	100	114	129	143	171	229	286	343	400	457	514	571	714	857	1000	1143	1429	1714	2000	2286	2571	2857	4286							
30	3	10	17	33	50	67	83	100	117	133	150	167	200	267	333	400	467	533	600	667	833	1000	1167	1333	1667	2000	2333	2667	3000	3333	5000							
25	4	12	20	40	60	80	100	120	140	160	180	200	240	320	400	480	560	640	720	800	1000	1200	1400	1600	2000	2400	2800	3200	3600	4000								
20	5	15	25	50	75	100	125	150	175	200	225	250	300	400	500	600	700	800	900	1000	1250	1500	1750	2000	2500	3000	3500	4000	4500	5000								
15	7	20	33	67	100	133	167	200	233	267	300	333	400	533	667	800	933	1067	1200	1333	1667	2000	2333	2667	3333	4000	4667											
10	10	30	50	100	150	200	250	300	350	400	450	500	600	800	1000	1200	1400	1600	1800	2000	2500	3000	3500	4000	5000													
5	20	60	100	200	300	400	500	600	700	800	900	1000	1200	1600	2000	2400	2800	3200	3600	4000	5000																	
3	33	100	167	333	500	667	833	1000	1167	1333	1500	1667	2000	2667	3333	4000	4667																					
1	100	300	500	1000	1500	2000	2500	3000	3500	4000	4500	5000																										
0.5	200	600	1000	2000	3000	4000	5000																															
0.3	333	1000	1667	3333	5000																																	
0.1	1000	3000	5000																																			
0.05	2000																																					

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Table B. LD_{50} values and classification of formulations when the route is DERMAL

First row = Dermal LD_{50} of the active ingredient

First column = Percent concentration of the active ingredient in the formulation

	Class Ia							Class Ib										Class II													Class III					
	1	5	10	20	30	40	50	60	70	80	90	100	120	140	160	180	200	250	300	350	400	450	500	600	700	800	900	1000	1500	2000	2500	3000	3500	4000	4500	5000
100	1	5	10	20	30	40	50	60	70	80	90	100	120	140	160	180	200	250	300	350	400	450	500	600	700	800	900	1000	1500	2000	2500	3000	3500	4000	4500	5000
95	1	5	11	21	32	42	53	63	74	84	95	105	126	147	168	189	211	263	316	368	421	474	526	632	737	842	947	1053	1579	2105	2632	3158	3684	4211	4737	
90	1	6	11	22	33	44	56	67	78	89	100	111	133	156	178	200	222	278	333	389	444	500	556	667	778	889	1000	1111	1667	2222	2778	3333	3889	4444	5000	
85	1	6	12	24	35	47	59	71	82	94	106	118	141	165	188	212	235	294	353	412	471	529	588	706	824	941	1059	1176	1765	2353	2941	3529	4118	4706		
80	1	6	13	25	38	50	63	75	88	100	113	125	150	175	200	225	250	313	375	438	500	563	625	750	875	1000	1125	1250	1875	2500	3125	3750	4375	5000		
75	1	7	13	27	40	53	67	80	93	107	120	133	160	187	213	240	267	333	400	467	533	600	667	800	933	1067	1200	1333	2000	2667	3333	4000	4667			
70	1	7	14	29	43	57	71	86	100	114	129	143	171	200	229	257	286	357	429	500	571	643	714	857	1000	1143	1286	1429	2143	2857	3571	4286	5000			
65	2	8	15	31	46	62	77	92	108	123	138	154	185	215	246	277	308	385	462	538	615	692	769	923	1077	1231	1385	1538	2308	3077	3846	4615				
60	2	8	17	33	50	67	83	100	117	133	150	167	200	233	267	300	333	417	500	583	667	750	833	1000	1167	1333	1500	1667	2500	3333	4167	5000				
55	2	9	18	36	55	73	91	109	127	145	164	182	218	255	291	327	364	455	545	636	727	818	909	1091	1273	1455	1636	1818	2727	3636	4545					
50	2	10	20	40	60	80	100	120	140	160	180	200	240	280	320	360	400	500	600	700	800	900	1000	1200	1400	1600	1800	2000	3000	4000	5000					
45	2	11	22	44	67	89	111	133	156	178	200	222	267	311	356	400	444	556	667	778	889	1000	1111	1333	1556	1778	2000	2222	3333	4444						
40	3	13	25	50	75	100	125	150	175	200	225	250	300	350	400	450	500	625	750	875	1000	1125	1250	1500	1750	2000	2250	2500	3750	5000						
35	3	14	29	57	86	114	143	171	200	229	257	286	343	400	457	514	571	714	857	1000	1143	1286	1429	1714	2000	2286	2571	2857	4286							
30	3	17	33	67	100	133	167	200	233	267	300	333	400	467	533	600	667	833	1000	1167	1333	1500	1667	2000	2333	2667	3000	3333	5000							
25	4	20	40	80	120	160	200	240	280	320	360	400	480	560	640	720	800	1000	1200	1400	1600	1800	2000	2400	2800	3200	3600	4000								
20	5	25	50	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1250	1500	1750	2000	2250	2500	3000	3500	4000	4500	5000								
15	7	33	67	133	200	267	333	400	467	533	600	667	800	933	1067	1200	1333	1667	2000	2333	2667	3000	3333	4000	4667											
10	10	50	100	200	300	400	500	600	700	800	900	1000	1200	1400	1600	1800	2000	2500	3000	3500	4000	4500	5000													
5	20	100	200	400	600	800	1000	1200	1400	1600	1800	2000	2400	2800	3200	3600	4000	5000																		
3	33	167	333	667	1000	1333	1667	2000	2333	2667	3000	3333	4000	4667																						
1	100	500	1000	2000	3000	4000	5000																													
0.5	200	1000	2000	4000																																
0.3	333	1667	3333																																	
0.1	1000	5000																																		

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Pesticide active ingredients, which occur in Tables 1-8, in CAS no order

For each active ingredient, the classification (Ia, Ib, II, III, or U (unlikely to pose an acute hazard in normal use, O (obsolete), FM (fumigant), and page number(s) are given.

CAS no	Class	Page	CAS no	Class	Page	CAS no	Class	Page
50-00-0	FM	53	78-87-5	O	48	99-30-9	III	35
50-29-3	II	26, 51	79-11-8	III	34	101-05-3	O	47
50-31-7	II	32	80-06-8	O	47	101-21-3	U	40
50-65-7	U	43	80-33-1	O	47	101-27-9	O	47
51-03-6	U	44	80-38-6	O	48	101-42-8	O	48
52-51-7	II	24	81-81-2	Ib	23	103-17-3	O	47
52-68-6	II	32	81-82-3	O	48	106-46-7	II	26
52-85-7	Ib	22	81-84-5	O	49	107-02-8	Ib	21
54-11-5	Ib	22	82-66-6	Ia	19	107-06-2	FM	51, 53
55-38-9	II	27	82-68-8	U	45	107-13-1	O	47
56-35-9	O	47	83-26-1	O	50	107-18-6	Ib	21
56-38-2	Ia	20, 52	83-59-0	O	50	107-49-3	O	50
56-72-4	Ib	21	83-79-4	II	31	108-25-8	O	50
57-24-9	Ib	23	84-65-1	U	39	108-62-3	II	29
57-74-9	II	25, 51	84-74-2	O	48	112-12-9	III	38
58-89-9	II	28, 51	85-34-7	O	47	113-48-4	III	37
60-51-5	II	27	86-50-0	Ib	21	114-26-1	II	31
60-57-1	O	48, 51	86-86-2	U	43	115-26-4	O	48
61-82-5	U	39	86-87-3	III	37	115-29-7	II	27
62-38-4	Ia	20, 51	86-88-4	O	47	115-31-1	O	49
62-73-7	Ib	21	87-17-2	O	50	115-32-2	II	26
62-74-8	Ia	20	87-86-5	Ib	22, 51	115-78-6	II	25
63-25-2	II	25	88-85-7	O	48, 51	115-90-2	O	48
66-81-9	O	48	90-43-7	III	37	116-01-8	O	48
72-20-8	O	48	91-20-3	O	49	116-06-3	Ia	19
72-43-5	U	43	92-52-4	III	34	116-16-5	O	49
72-54-8	O	50	93-71-0	O	47	116-29-0	U	45
74-83-9	FM	53	93-72-1	O	48	117-18-0	U	45
74-90-8	FM	53	93-75-4	O	50	118-74-1	Ia	19, 51
75-15-0	O	47	93-76-5	O	50, 51	118-75-2	O	47
75-21-8	FM	51, 53	94-74-6	II	29	119-12-0	II	31
75-60-5	II	27	94-75-7	II	26	120-23-0	II	30
75-99-0	U	40	94-81-5	II	29	120-62-7	O	50
76-03-9	II	32	94-82-6	II	26	121-75-5	III	36
76-06-2	FM	53	94-96-2	O	48	122-14-5	II	27
76-44-8	O	49, 51	95-06-7	O	50	122-34-9	U	45
76-87-9	II	28	96-12-8	O	48	122-42-9	U	44
77-06-5	U	41	96-24-2	Ib	21	122-88-3	III	35
78-34-2	O	48	97-17-6	O	48	123-33-1	U	43
78-57-9	O	49	97-23-4	II	26	123-88-6	O	49, 51

Pesticide active ingredients, which occur in Tables 1-8, in CAS no order, continued

For each active ingredient, the classification (Ia, Ib, II, III, or U (unlikely to pose an acute hazard in normal use, O (obsolete), FM (fumigant), and page number(s) are given.

CAS no	Class	Page	CAS no	Class	Page	CAS no	Class	Page
124-58-3	II	30	300-76-5	II	30	682-80-4	O	48
125-67-9	II	27	301-12-2	Ib	22	709-98-8	II	31
126-07-8	O	49	309-00-2	O	47, 51	731-27-1	U	46
126-22-7	O	47	314-40-9	U	39	732-11-6	II	30
126-75-0	O	48	314-42-1	O	49	741-58-2	II	24
131-11-3	U	41	315-18-4	O	49	756-09-2	U	42
131-89-5	O	48	327-98-0	O	50	759-94-4	II	27
132-66-1	U	43	330-54-1	III	35	786-19-6	O	47
133-06-2	U	39	330-55-2	III	36	834-12-8	II	24
133-07-3	U	42	333-41-5	II	26	841-06-5	O	49
133-90-4	O	47	371-86-8	O	49	886-50-0	III	38
134-31-6	O	49	465-73-6	O	49	900-95-8	II	27
134-62-3	III	35	467-69-6	U	42	919-76-6	O	47
136-25-4	O	48	470-90-6	Ib	21	919-86-8	Ib	21
137-26-8	II	32, 51	485-31-4	O	47, 51	944-22-9	O	49
137-30-4	II	33	495-73-8	O	47	947-02-4	O	50
137-42-8	II	29	502-39-6	O	49, 51	950-10-7	O	49
139-40-2	U	44	502-55-6	O	48	950-37-8	Ib	22
140-41-0	O	49	507-60-8	O	50	957-51-7	II	27
140-56-7	O	48	510-15-6	O	47, 51	973-21-7	II	27
140-57-8	O	47	513-77-9	O	47	991-42-4	O	49
141-03-7	O	48	532-34-3	O	47	999-81-5	II	25
141-66-2	Ib	21	533-74-4	II	26	1014-69-3	O	48
142-59-6	II	30	534-52-1	Ib	22, 51	1014-70-6	II	31
143-33-9	Ib	23	535-89-7	O	48	1031-47-6	O	50
143-50-0	O	47	542-75-6	FM	53	1071-83-6	III	36
148-79-8	III	38	555-37-3	U	43	1085-98-9	U	40
149-26-8	O	48	556-22-9	O	49	1086-02-8	O	50
150-68-5	O	49	556-61-6	II	30	1113-02-6	Ib	22
152-16-9	O	50	563-12-2	II	27	1114-71-2	II	30
156-62-7	O	47	584-79-2	II	24	1129-41-5	II	30
297-78-9	O	49	584-79-2	II	24	1134-23-2	III	35
297-97-2	O	50	590-28-3	O	50	1194-65-6	III	35
297-99-4	Ia	20, 52	592-01-8	Ia	19	1303-96-4	III	34
298-00-0	Ia	19, 51	608-73-1	II	28, 51	1314-84-7	Ib	23
298-02-2	Ia	20	640-15-3	Ib	23	1317-39-1	II	25
298-03-3	O	48	640-19-7	Ib	22, 51	1327-53-3	O	47
298-04-4	Ia	19	644-64-4	O	48	1332-40-7	II	25
299-84-3	O	48	650-51-1	III	37	1420-06-3	O	50
299-86-5	O	48	671-04-5	O	47	1420-07-1	Ib	21

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1468-37-7	O	48	2163-69-1	O	48	2655-19-8	O	47
1563-66-2	Ib	21, 51	2163-79-3	O	49	2669-32-1	O	49
1582-09-8	U	46	2164-08-1	II	29	2674-91-1	O	48
1593-77-7	U	41	2164-08-1	U	43	2675-77-6	O	47
1596-84-5	U	40	2164-09-2	O	47	2693-61-0	O	49
1610-17-9	O	47	2164-17-2	U	42	2699-79-8	FM	53
1610-18-0	III	37	2212-67-1	II	30	2759-71-9	O	48
1646-88-4	O	47	2227-13-6	O	50	2764-72-9	II	27
1689-83-4	II	29	2227-47-0	O	48	2778-04-3	O	48
1689-84-5	II	24	2275-14-1	O	49	2797-51-5	II	31
1698-60-8	III	34	2275-18-5	O	50	2813-95-8	O	48
1715-40-8	O	47	2275-23-2	Ib	23	2921-88-2	II	25
1746-81-2	III	36	2303-16-4	O	48	2980-64-5	Ib	22, 51
1754-58-1	O	48	2303-17-5	III	38	2941-55-1	O	48
1836-75-5	O	49	2307-49-5	O	50	3060-89-7	U	43
1836-77-7	O	47	2307-68-8	U	44	3134-12-1	O	49
1861-32-1	III	34	2310-17-0	II	30	3337-71-1	III	34
1861-40-1	U	39	2312-35-8	III	37	3347-22-6	II	27
1897-45-6	U	40	2312-76-7	Ib	22, 51	3383-96-8	III	37
1910-42-5	II	30	2385-85-5	O	49	3495-42-9	O	47
1912-24-9	III	34	2425-06-1	Ia	19, 51	3547-33-9	U	42
1912-25-0	O	49	2425-10-7	II	33	3689-24-5	Ia	20
1912-26-1	III	38	2439-01-2	II	25	3691-35-8	Ia	19
1918-00-9	II	26	2439-10-3	II	27	3734-95-0	O	48
1918-02-1	U	44	2439-99-8	O	49	3737-22-2	U	41
1918-11-2	O	50	2487-01-6	O	49	3740-92-9	U	41
1918-13-4	O	48	2497-07-6	O	49	3766-60-7	O	47
1918-16-7	II	31	2514-53-6	O	48	3766-81-2	II	27
1929-77-7	O	50	2536-31-4	O	47	3792-59-4	O	48
1929-82-4	II	30	2540-82-1	O	49	3811-49-2	O	48
1929-88-0	O	47	2550-75-6	O	47	3813-05-6	III	34
1967-16-4	O	47	2587-90-8	O	48	3861-47-0	II	29
1982-47-4	O	47	2593-15-9	III	35	3878-19-1	II	28
1982-49-6	U	45	2595-54-2	Ib	22	4104-14-7	O	50
2008-41-5	III	34	2597-03-7	II	30	4147-51-7	O	48
2032-59-9	O	47	2631-37-0	O	50	4151-50-2	II	32
2032-65-7	Ib	22	2631-40-5	II	29	4234-79-1	O	49
2079-00-7	Ib	21	2636-26-2	II	25	4301-50-2	O	49
2104-64-5	Ia	19	2642-71-9	Ib	21	4482-55-7	O	48
2104-96-3	O	47	2655-14-3	II	33	4489-31-0	O	49

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4636-83-3	O	49	7778-44-1	Ib	21	13598-36-2	U	44
4658-28-0	O	47	7784-40-9	Ib	22	13684-56-5	U	40
4726-14-1	O	49	7784-46-5	Ib	23	13684-63-4	U	44
4824-78-6	O	47	7803-51-2	FM	53	13952-84-6	II	25
4849-32-5	O	49	8001-35-2	O	47, 51	14214-32-5	O	48
5131-24-8	O	48	8003-05-2	O	50, 51	14255-88-0	O	48
5221-53-4	III	35	8003-34-7	II	31	14437-17-3	O	47
5234-68-4	III	34	8018-01-7	U	43	14484-64-1	U	41
5259-88-1	III	37	8051-02-3	O	50	14491-59-9	O	48
5598-13-0	III	34	8065-36-9	O	47	14750-35-4	U	40
5707-69-7	O	48	9006-42-2	U	43	14816-18-3	II	30
5787-96-2	Ib	22, 51	10004-44-1	III	36	14816-20-7	O	47
5827-05-4	O	49	10071-13-3	U	43	15096-52-3	U	40
5834-96-8	O	47	10112-91-1	II	29, 51	15263-53-3	II	25
5836-10-2	O	47	10265-92-6	Ib	22, 51	15299-99-7	U	43
5836-29-3	Ib	21	10311-84-9	O	48	15302-91-7	II	29
5902-51-2	U	45	10380-28-6	U	44	15310-01-7	O	47
5915-41-3	III	38	10453-86-8	III	37	15457-05-3	O	49
6164-98-3	O	47, 51	10537-47-0	O	49	15545-48-9	U	40
6392-46-7	O	47	10552-74-6	U	43	15845-66-2	U	42
6616-80-4	O	48	10605-21-7	U	40	15879-93-3	II	25
6923-22-4	Ib	22, 51	12002-03-8	Ib	22	15972-60-8	II	24
6988-21-2	O	48	12057-74-8	FM	53	16118-49-3	U	40
7055-03-0	O	49	12071-83-9	U	44	16484-77-8	II	29
7085-19-0	II	29	12122-67-7	U	46	16672-87-0	III	35
7159-99-1	O	49	12407-86-2	O	50	16752-77-5	Ib	22
7187-36-7	O	49	12427-38-2	U	43	16893-85-9	O	50
7287-19-6	III	37	12771-68-5	III	34	17029-22-0	O	49
7292-16-2	*O*	*50*	13067-93-1	O	48	17040-19-6	O	48
7446-18-6	Ib	23	13071-79-9	Ia	20	17109-49-8	Ib	22
7487-94-7	Ia	19	13121-70-5	II	25	17606-31-4	II	24
7547-66-2	II	26	13171-21-6	Ia	20, 52	17804-35-2	U	39, 51
7681-49-4	O	50	13181-17-4	O	47	18181-70-9	O	49
7681-93-8	III	37	13194-48-4	Ia	19	18181-80-1	U	39
7696-12-0	U	45	13356-08-6	III	36	18467-77-1	U	41
7700-17-6	O	48	13360-45-7	O	47	18691-97-9	III	36
7704-34-9	III	37	13457-18-6	II	31	18854-04-8	Ib	22
7758-98-7	II	25	13516-27-3	II	29	19044-88-3	U	44
7773-06-0	III	34	13577-71-4	O	49	19408-46-9	U	43
7775-09-9	II	31	13593-03-8	II	31	19622-08-3	O	50

Pesticide active ingredients, which occur in Tables 1-8, in CAS no order, continued

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19666-30-9	U	44	24934-91-6	Ia	19	31895-22-4	II	32
19691-80-6	O	47	25057-89-0	II	24	32407-99-1	O	50, 51
19937-59-8	III	36	*25311-71-1*	*O*	*49*	32534-96-6	O	48
20354-26-1	O	49	25319-90-8	II	29	32791-87-0	U	40
20427-59-2	II	25	25366-23-8	O	50	32809-16-8	U	44
20856-57-9	O	47	25954-13-6	III	36	32861-85-1	O	47
20859-73-8	FM	53	26002-80-2	U	44	33089-61-1	II	24
21087-64-9	II	30	26087-47-8	II	29	33245-39-5	II	28
21540-35-2	O	49	26129-32-8	O	48	33629-47-9	II	24
21542-18-6	O	49	26225-79-6	U	41	33693-04-8	II	32
21548-32-3	O	49	26259-45-0	O	50	33820-53-0	O	49
21609-90-5	O	49	26399-36-0	O	50	33878-50-1	O	47
21725-46-2	II	25	26530-20-1	II	30	34014-18-1	II	32
21908-53-2	Ib	22, 51	26644-46-2	U	46	34123-59-6	II	29
21923-23-9	O	48	26718-65-0	Ia	19	34205-21-5	III	35
22224-92-6	Ib	22	26766-27-8	O	50	34256-82-1	III	34
22248-79-9	III	38	27314-13-2	U	43	34264-24-9	O	50
22259-30-9	Ib	22	27355-22-2	U	44	34462-96-9	O	49
22274-74-0	O	47	27386-64-7	O	49	34643-46-4	II	31
22571-07-9	O	50	27541-88-4	O	50	34681-10-2	Ib	21
22781-23-3	II	24	27605-76-1	III	37	34681-23-7	Ib	21
22936-75-0	III	35	28217-97-2	O	47	35256-85-0	O	47
23031-36-9	II	31	28249-77-6	II	32	35256-85-0	U	45
23103-98-2	II	31	28434-01-7	U	39	35367-38-5	III	35
23135-22-0	Ib	22	28559-00-4	O	48	35400-43-2	O	50
23184-66-9	III	34	28772-56-7	Ia	19	35554-44-0	II	28
23505-41-1	O	50	28805-78-9	O	49	35575-96-3	II	24
23560-59-0	Ib	22	29091-05-2	III	35	36335-67-8	II	24
23564-05-8	U	45	29091-21-2	U	44	36519-00-3	O	50
23564-06-9	O	50	29104-30-1	O	47	36614-38-7	O	49
23783-98-4	Ia	19, 51	29173-31-7	O	49	36734-19-7	III	36
23947-60-6	III	35	29232-93-7	II	31	36756-79-3	U	45
23950-58-5	U	44	29672-19-3	O	49	37248-47-8	U	46
24017-47-8	Ib	23	29973-13-5	Ib	22	37407-77-5	O	47
24151-93-7	II	30	30043-49-3	O	48	37764-25-3	III	35
24201-58-9	O	48	30560-19-1	II	24	37893-02-0	O	48
24353-58-0	O	48	30979-48-7	O	49	37894-46-5	O	48
24579-73-5	U	44	31218-83-4	Ib	23	37924-13-3	O	50
24691-76-7	O	50	31251-03-3	O	49	38260-54-7	O	48
24691-80-3	U	41	31848-11-0	O	47	38727-55-8	O	48

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39300-45-3	II	27	53780-34-0	II	29	62610-77-9	II	29
39515-40-7	II	26	54406-48-3	III	35	62850-32-2	II	27
39603-48-0	O	47	54593-83-8	Ia	19	62865-36-5	U	40
40483-25-2	II	26	54864-61-8	O	49	62924-70-3	U	41
40487-42-1	II	30	55179-31-2	U	39	63278-33-1	O	48
40596-69-8	U	43	55219-65-3	II	32	63284-71-9	II	30
41083-11-8	II	24	55283-68-6	U	41	63333-35-7	Ia	19
41198-08-7	II	31	55285-14-8	II	25	63935-38-6	U	40
41205-09-8	U	42	55290-64-7	II	26	64249-01-0	II	24
41295-28-7	O	49, 51	55335-06-3	II	32	64257-84-7	II	27
41394-05-2	II	29	55511-98-3	O	47	64491-92-5	O	49
41483-43-6	III	34	55512-33-9	III	37	64628-44-0	U	46
41814-78-2	II	32	55634-91-8	III	34	64902-72-3	U	40
42509-80-8	O	49	55814-41-0	U	43	65907-30-4	Ib	22
42576-02-3	U	39	55861-78-4	II	29	65934-95-4	O	48
42588-37-4	O	49	56073-07-5	Ia	19	66063-05-6	U	44
42609-52-9	III	35	56073-10-0	Ia	19	66215-27-8	III	35
42609-73-4	U	43	56425-91-3	II	28	66230-04-4	II	27
42874-03-3	U	44	57018-04-9	U	45	66246-88-6	III	37
43121-43-3	II	32	57052-04-7	O	49	66332-96-5	U	42
43222-48-6	II	26	57130-91-3	O	50	66841-25-6	II	32
50471-44-8	U	46	57369-32-1	II	31	66952-49-6	II	30
50512-35-1	II	29	57375-63-0	O	49	67129-08-2	III	36
50563-36-5	II	26	57646-30-7	II	28	67306-00-7	II	27
50594-66-6	II	24	57754-85-5	III	35	67375-30-8	II	26
51218-45-2	III	36	57837-19-1	II	29	67485-29-4	II	28
51218-49-6	U	44	57966-95-7	II	25	67564-91-4	III	36
51235-04-2	II	28	58011-68-0	U	45	67747-09-5	II	31
51308-54-4	O	47	58138-08-2	O	50	68038-71-1	III	34
51487-69-5	O	48	58667-63-3	O	48	68085-85-8	II	25
51630-58-1	II	28	58810-48-3	III	37	68228-20-6	O	50
51707-55-2	III	38	59669-26-0	II	32	68359-37-5	Ib	21
52304-36-6	U	41	59756-60-4	U	42	68505-69-1	III	34
52315-07-8	II	26	60168-88-9	III	36	69309-47-3	O	50
52315-07-8	Ib	21	60207-31-0	II	24	69327-76-0	III	34
52645-53-1	II	30	60207-90-1	II	31	69335-91-7	O	48
52888-80-9	II	31	60207-93-4	O	48	69377-81-7	U	42
52918-63-5	II	26	60568-05-0	O	49	69409-94-5	O	49
53112-28-0	III	37	61213-25-0	III	36	69581-33-5	O	48

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69806-34-4	II	28	82110-72-3	O	48	96489-71-3	II	31
70124-77-5	Ib	22	82211-24-3	U	42	97886-45-8	U	41
70193-21-4	O	50	82558-50-7	U	42	98389-04-9	U	45
71048-99-2	II	24	82560-54-1	II	24	98730-04-2	U	39
71422-67-8	U	40	82657-04-3	II	24	98967-40-9	U	42
71561-11-0	II	31	83055-99-6	U	39	99283-00-8	III	34
71626-11-4	III	34	83066-88-0	III	36	99387-89-0	II	32
72178-02-0	II	28	83121-18-0	U	45	101007-06-1	U	39
73250-68-7	U	43	83130-01-2	II	24	101205-02-1	III	35
73886-28-9	O	49	83164-33-4	III	35	101463-69-8	III	36
74051-80-2	III	37	83657-22-1	II	33	102851-06-9	III	36
74070-46-5	U	39	83657-24-3	III	35	103112-35-2	U	41
74115-24-5	III	35	83733-82-8	O	49	104030-54-8	U	40
74223-56-6	U	45	84087-01-4	III	37	104653-34-1	Ia	19
74223-64-6	U	43	84332-86-5	III	34	106040-48-6	U	46
74712-19-9	U	39	84496-56-0	U	40	107534-96-3	II	32
74738-17-3	U	41	85509-19-9	II	28	108173-90-6	II	28
74782-23-3	U	44	85785-20-2	III	35	110235-47-7	U	43
75736-33-3	O	48	86479-06-3	U	42	110488-70-5	U	41
76578-12-6	II	31	86598-92-7	U	42	111479-05-1	U	44
76608-88-3	O	50	87130-20-9	U	40	111991-09-4	U	43
76674-21-0	II	28	87310-56-3	O	47	111988-49-9	II	32
76738-62-0	II	30	*87674-68-8*	*II*	*27*	112143-82-5	II	32
77458-01-6	II	31	87757-18-4	O	49	112226-61-6	III	36
77501-60-1	II	28	87818-31-3	II	25	112281-77-3	II	32
77732-09-3	II	30	87820-88-0	II	32	112410-23-8	U	45
78587-05-0	U	42	88283-41-4	III	37	112839-32-4	O	49
79127-80-3	U	41	88485-37-4	II	28	113036-87-6	U	44
79277-27-3	U	45	88671-89-0	II	30	114369-43-6	III	36
79538-32-2	Ib	23	89269-64-7	II	28	116170-30-0	O	50
79983-71-4	III	36	90035-08-8	Ia	19	116255-48-2	II	24
80060-09-9	III	35	90134-59-1	III	36	*116714-46-6*	*U*	*43*
80844-07-1	U	41	90717-03-6	U	45	118134-30-8	II	32
81334-34-1	U	42	94050-52-9	U	41	118712-89-3	U	46
81335-37-7	U	42	94361-06-5	II	26	119168-77-3	II	32
81335-77-5	U	42	94593-91-6	U	40	119446-68-3	II	26
81405-85-8	U	42	95465-99-9	Ib	21	119738-06-6	II	31
81412-43-3	II	32	95721-12-3	O	48	120068-37-3	II	28
81777-89-1	II	25	95737-68-1	U	45	120162-55-2	U	39
82097-50-5	U	46	96182-53-5	Ia	20	120928-09-8	II	27

Pesticide active ingredients, which occur in Tables 1-8, in CAS no order, continued

For each active ingredient, the classification (Ia, Ib, II, III, or U (unlikely to pose an acute hazard in normal use, O (obsolete), FM (fumigant), and page number(s) are given.

CAS no	Class	Page	CAS no	Class	Page	CAS no	Class	Page
121451-02-3	U	44	131929-63-0	U	45	*149877-41-8*	*U*	*39*
122008-85-9	U	40	131983-72-7	III	38	*150114-71-9*	*U*	*39*
122453-73-0	II	25	*134098-61-6*	*II*	*27*	*156052-68-5*	*U*	*46*
122931-48-0	U	45	136191-56-5	U	45	161050-58-4	U	43
123343-16-8	III	37	136849-15-5	U	40	168316-95-8	III	37
124495-18-7	U	45	138164-12-2	II	24	*173584-44-6*	*II*	*29*
125116-23-6	II	29	138261-41-3	II	28	*178928-70-6*	*U*	*45*
125401-75-4	III	34	139528-85-1	U	43	181274-17-9	U	41
126535-15-7	U	46	140923-17-7	U	42	*187166-40-1*	*U*	*45*
126833-17-8	U	41	*141517-21-7*	*U*	*46*	*188425-85-6*	*U*	*39*
130000-40-7	U	45	142459-58-3	II	28	*203313-25-1*	*III*	*37*
131341-86-1	*U*	*41*	144740-54-5	U	42	219714-96-2	U	44
131807-57-3	U	41	145701-21-9	U	40	*374726-62-2*	*U*	*43*
131860-33-8	U	39	145701-23-1	U	41	*500008-45-7*	*U*	40
131929-60-7	U	45	149253-65-6	U	42			

INDEX. CLASSIFICATION OF ACTIVE PESTICIDE INGREDIENTS

Ia = Extremely hazardous; Ib = Highly hazardous; II = Moderately hazardous; III = slightly hazardous; U = Unlikely to present acute hazard in normal use; FM = Fumigant, not classified; O = Obsolete as pesticide, not classified.

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Iprodione (Ref: ROP 500F)

(Also known as: glycophene; NRC 910)

Last updated: 11/11/2019

PPDB

GENERAL INFORMATION

Description	A post-harvest fungicide used to control diseases on fruit, vegetables and other crops
Example pests controlled	*Botrytis, Minilia, Rhizoctonia, Sclerotinia* - damping-off
Example applications	Vegetables including carrots; Lettuce; Ornamentals; Fruit including apples, pears, plums, apricots and peaches; Root crops; Cotton; Sunflowers; Turf
Efficacy & activity	-
Availability status	Current
Introduction & key dates	1997, first reported

UK regulatory status

UK approval status	Approved

EC Regulation 1107/2009 (repealing 91/414)

EC Directive 91/414 Status	Not approved
Dossier rapporteur/co-rapporteur	France/Belgium
Date inclusion expires	Expired
EU Candidate for substitution (CfS)	No
Listed in EU database	Yes
Approved for use (✓) or known to be used (#) in the following EU-27 Member States	

AT	BE	BG	CY	CZ	DE	DK	EE	EL
✓	✓	✓	✓	✓	✓		✓	✓
ES	**FI**	**FR**	**HR**	**HU**	**IE**	**IT**	**LT**	**LU**
✓	✓	✓	✓	✓	✓	✓	✓	✓
LV	**MT**	**NL**	**PL**	**PT**	**RO**	**SE**	**SI**	**SK**
✓		✓	✓	✓	✓		✓	✓

Also used in

Also used in	Australia, USA

Chemical structure

Isomerism	A structural isomer (RP-30228) exists which is also a major metabolite
Chemical formula	$C_{13}H_{13}Cl_2N_3O_3$
Canonical SMILES	CC(C)NC(=O)N1CC(=O)N(C1=O)C2=CC(=CC(=C2)Cl)Cl
Isomeric SMILES	No data
International Chemical Identifier key (InChIKey)	ONUFESLQCSAYKA-UHFFFAOYSA-N
International Chemical Identifier (InChI)	InChI=1S/C13H13Cl2N3O3/c1-7(2)16-12(20)17-6-11(19)18(13(17)21)10-4-8(14)3-9(15)5-10/h3-5,7H,6H2,1-2H3,(H,16,20)

2D structure diagram/image available?	Yes

General status

Pesticide type	Fungicide
Substance group	Dicarboximide
Minimum active substance purity	960 g kg^{-1}
Known relevant impurities	EU dossier - None declared
Substance origin	Synthetic
Mode of action	Contact action with protectant and some eradicant activity. Signal transduction inhibitor.
CAS RN	36734-19-7
EC number	253-178-9
CIPAC number	278
US EPA chemical code	109801
PubChem CID	37517
Molecular mass	330.17
PIN (Preferred Identification Name)	-
IUPAC name	3-(3,5-dichlorophenyl)-N-isopropyl-2,4-dioxoimidazolidine-1-carboxamide
CAS name	3-(3,5-dichlorophenyl)-N-(1-methylethyl)-2,4-dioxo-1-imidazolidinecarboxamide
Other status information	-
Relevant Environmental Water Quality Standards	-
Herbicide Resistance Classification (HRAC)	Not applicable
Herbicide Resistance Classification (WSSA)	Not applicable
Insecticide Resistance Classification (IRAC)	Not applicable
Fungicide Resistance Classification (FRAC)	2
Examples of recorded resistance	-
Physical state	Colourless crystals
Related substances & organisms	• thiophanate-methyl • solvent naphtha

Formulations

Property	Value

Property	Value
Example manufacturers & suppliers of products using this active now or historically	• Rovral WG • Surpass • Governor • 3336Plus • Chipco Green •
Example products using this active	• AgriGuard • BASF • Headland • Rhone-Poulenc
UK LERAP status	None
Formulation and application details	Often supplied as a soluble concentrate or wettable granules

ENVIRONMENTAL FATE

Property		Value	Source; quality score; and other information	Interpretation
Solubility - In water at 20 °C (mg l^{-1})		6.8	A5	Low
Solubility - In organic solvents at 20 °C (mg l^{-1})		590	A5 Hexane	-
		147000	A5 Toluene	-
		342000	A5 Acetone	-
		225000	A5 Ethyl acetate	-
Melting point (°C)		134	A5	-
Boiling point (°C)		-	-	-
Degradation point (°C)		233	A4	-
Flashpoint (°C)		150	A3	-
Octanol-water partition coefficient at pH 7, 20 °C	P	1.00 X 10^{03}	Calculated	-
	Log P	3.0	A4 at 25 °C	Moderate
Bulk density (g ml^{-1})		1.0	L3	-
Dissociation constant pKa) at 25 °C		Not applicable	A5	-
		No dissociation		
Vapour pressure at 20 °C (mPa)		0.0005	A5	Low volatility
Henry's law constant at 25 °C (Pa m^3 mol^{-1})		7.00 X 10^{-06}	A5	Non-volatile
GUS leaching potential index		0.43	Calculated	Low leachability
SCI-GROW groundwater index (µg l^{-1}) for a 1 kg ha^{-1} or 1 l ha^{-1} application rate	Value	8.20 X 10^{-03}	Calculated	-
	Note	-		

Property	Value	Source; quality score; and other information	Interpretation
Potential for particle bound transport index	Medium	Calculated	-
Maximum UV-vis absorption L mol^{-1} cm^{-1}	204.5nm = 44333, 295nm in acetonitrile = <10	A5	-
Surface tension (mN m^{-1})	73	A5	-

Degradation

Property		Value	Source; quality score; and other information	Interpretation
General biodegradability		-		
Soil degradation (days) (aerobic)	DT_{50} (typical)	36.2	A5	Moderately persistent
	DT_{50} (lab at 20 °C)	26.2	A5	Non-persistent
	DT_{50} (field)	11.7	A5	Non-persistent
	DT_{90} (lab at 20 °C)	126.8	A5	Persistent
	DT_{90} (field)	73.2	A5	-
	DT_{50} modelling endpoint	-	-	-
	Note	EU dossier (DAR 2016) Lab studies DT_{50} range 13.4-36.2 days; DT_{90} range 53.9-126.8 days, Soils= 6; Field studies DT_{50} range 3.5-35.3 days, DT_{90} range 29.0-196.9 days, Soils = 5; Other sources: DT_{50} 14 days (DW4)		
Dissipation rate RL_{50} on plant matrix	Value	9.7	R4	-
	Note	Published literature RL_{50} range 2.5-51.2 days, 8 field & undercover grown crops, various matrices, n=14		
Dissipation rate RL_{50} on and in plant matrix	Value	8.7	R4	-
	Note	Published literature RL_{50} range 3.3-23.1 days, 8 field & undercover grown crops, various matrices, n=9		
Aqueous photolysis DT_{50} (days) at pH 7	Value	67	A5	Stable
	Note	pH sensitive: DT_{50} 67 days at pH 5, 1 hour at pH 9, 25 °C simulated sunlight		
Aqueous hydrolysis DT_{50} (days) at 20 °C and pH 7	Value	4.5	A5	Non-persistent
	Note	pH sensitive: DT_{50} 140 days at pH 5, 0.2 days at pH 8		
Water-sediment DT_{50} (days)		4.0	A5	Fast
Water phase only DT_{50} (days)		2.0	A5	Moderately fast

Soil adsorption and mobility

Property		Value	Source; quality score; and other information	Interpretation
Linear	K_d	-	DW3	Slightly mobile
	K_{oc}	700		
	Notes and range	-		

Property		Value	Source; quality score; and other information	Interpretation
Freundlich	K_f	16.36	A5	Slightly mobile
	K_{foc}	3927		
	$^1/_n$	0.889		
	Notes and range	EU dossier K_f range 2.16-43.1 mL g^{-1}, K_{foc} range 223-2056 mL g^{-1}, $^1/_n$ range 0.70-0.96, Soils=9		
pH sensitivity		No		

Key metabolites

Metabolite	Formation medium	Estimated maximum occurrence fraction	1107/2009 relevancy
N-(3,5-dichlorophenyl)3-isopropyl-2,4-dioxoimidazoline-1-carboxamide (Ref: RP-30228)	Soil	0.295	Major fraction, Relevant (anaerobic soils)
1-(3,5-dichlorophenyl)-5-isopropyl biuret (Ref: RP-36221)	Soil	0.127	Major fraction, Relevant
N-(3,5-dichlorophenylcarbamoyl)-N-isopropylcarbamoyl-glycine (Ref: RP35606)	Soil	0.255	Major fraction, Relevant
3,5-dichloroaniline (Ref: RP32596)	Soil	0.126	Major fraction, Relevant
3-(3,5-dichlorophenyl)-2,4-dioxoimidazolidine (Ref: RP25040)	Soil	0.078	Minor fraction, Relevant

Other known metabolites

Metabolite name and reference	Aliases	Formation medium / Rate	Estimated maximum occurrence fraction	Metabolising enzymes
1-[(3,5-dichlorophenyl)carbamoymethyl]-3-isopropylurea (Ref: RP 37176)	-	-	-	-

ECOTOXICOLOGY

Property		Value	Source; quality score; and other information	Interpretation
Bio-concentration factor	BCF (l kg^{-1})	70	A5 Whole fish	Low potential
	CT_{50} (days)	Not available		-
Mammals - Acute oral LD_{50} (mg kg^{-1})		> 2000	A5 Rat	Low
Mammals - Short term dietary NOEL	(mg kg^{-1})	31	A5 Rat	High
	(ppm diet)	300		-
Birds - Acute LD_{50} (mg kg^{-1})		> 2000	A5 *Colinus virginianus*	Low

Property		Value	Source; quality score; and other information	Interpretation
Birds - Short term dietary (LC_{50}/LD_{50})		> 5620 mg kg feed^{-1}	A5 *Colinus virginianus*	-
Fish - Acute 96 hour LC_{50} (mg l^{-1})		3.7	A5 *Lepomis macrochirus*	Moderate
Fish - Chronic 21 day NOEC (mg l^{-1})		4.1	A5 *Oncorhynchus mykiss*	Moderate
Aquatic invertebrates - Acute 48 hour EC_{50} (mg l^{-1})		0.66	A5 *Daphnia magna*	Moderate
Aquatic invertebrates - Chronic 21 day NOEC (mg l^{-1})		0.17	A5 *Daphnia magna*	Moderate
Aquatic crustaceans - Acute 96 hour LC_{50} (mg l^{-1})		-	-	-
Sediment dwelling organisms - Acute 96 hour LC_{50} (mg l^{-1})		-	-	-
Sediment dwelling organisms - Chronic 28 day NOEC, static, water (mg l^{-1})		0.1	A5 *Chironomus riparius*	Moderate
Sediment dwelling organisms - Chronic 28 day NOEC, sediment (mg kg^{-1})		-	-	-
Aquatic plants - Acute 7 day EC_{50}, biomass (mg l^{-1})		1	F3 *Lemna gibba*	Moderate
Non-target plants		-	-	-
		-	-	-
Algae - Acute 72 hour EC_{50}, growth (mg l^{-1})		1.8	A5 *Raphidocelis subcapitata*	Moderate
Algae - Chronic 96 hour NOEC, growth (mg l^{-1})		3.2	Q2 Unknown species	Low
Honeybees (*Apis* spp.)	Contact acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	> 100	A5 *Apis mellifera*	Low
	Oral acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	> 100	A5 *Apis mellifera*	Low
	Unknown mode acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	-	-	-
Bumblebees (*Bombus* spp.)	Contact acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	-	-	-
		-		

Property		Value	Source; quality score; and other information	Interpretation
	Oral acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	-		
Mason bees (*Osmia* spp.)	Contact acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	> 125	R4 *Osmia lignaria*	Low
	Oral acute LD_{50} (worst case from 24, 48 and 72 hour values - µg bee^{-1})	> 125	R4 *Osmia lignaria*	Low
Other pollinators (1)	Acute LD_{50} (worst case from 24, 48 and 72 hour values - µg $insect^{-1}$)	-	-	-
	Mode of exposure	-		
Other pollinators (2)	Acute LD_{50} (worst case from 24, 48 and 72 hour values - µg $insect^{-1}$)	-	-	-
	Mode of exposure	-		
Earthworms - Acute 14 day LC_{50} (mg kg^{-1})		> 500	A5 *Eisenia foetida* corr	Moderate
Earthworms - Chronic NOEC, reproduction (mg kg^{-1})		500	A5 *Eisenia foetida* corr	Low
Other soil macro-organisms	Acute LC_{50} (mg kg^{-1})	-	-	-
	Chronic NOEC (mg kg^{-1})	750	A5 *Folsomia candida* corr	-
Other arthropod (1)	LR_{50} g ha^{-1}	-	-	-
	% Effect	-9.0	Beneficial capacity [Dose:0.75 kg ha^{-1}] A5 *Aphidius rhopalosiphi* adult	-
Other arthropod (2)	LR_{50} g ha^{-1}	-	-	-
	% Effect	84.3	Beneficial capacity [Dose: 0.75 kg ha^{-1}] A5 *Typhlodromus pyri* protonymph	-

Property		Value	Source; quality score; and other information	Interpretation
Soil micro-organisms		Nitrogen mineralisation: No significant adverse effect Carbon mineralisation: No significant adverse effect	A5 Dose: 10 mg kg⁻¹ soil	-
Mesocosm study data	NOEAEC mg l⁻¹	-	-	-
	NOEAEC mg l⁻¹	-	-	-

HUMAN HEALTH AND PROTECTION

General

Property		Value	Source; quality score; and other information	Interpretation
Threshold of Toxicological Concern (Cramer Class)		High (class III)	-	-
Mammals - Acute oral LD_{50} (mg kg^{-1})		> 2000	A5 Rat	Low
Mammals - Dermal LD_{50} (mg kg^{-1} body weight)		2000	A5 Rat	-
Mammals - Inhalation LC_{50} (mg l^{-1})		> 5.16	A5 Rat. 4 hr (whole body)	-
Other Mammal toxicity endpoints		-	-	-
ADI - Acceptable Daily Intake (mg kg^{-1} bw day^{-1})		0.06	A5 Rat SF=100	-
ARfD - Acute Reference Dose (mg kg^{-1} bw day^{-1})		None allocated	A5	-
AAOEL - Acute Acceptable Operator Exposure Level (mg kg^{-1} bw day^{-1})		-	-	-
AOEL - Acceptable Operator Exposure Level - Systemic (mg kg^{-1} bw day^{-1})		0.3	A5 Rat 90 day SF=100	-
Dermal penetration studies (%)		0.2-12	A5 concentration dependent	-
Dangerous Substances Directive 76/464		-	-	-
Exposure Routes	Public	No unacceptable risks to bystanders identified		
	Occupational	Potential risk identified - PPE/PPC advised		
European MRLs		EU MRL pesticide database		
Drinking Water Standards		-	-	-
Drinking Water MAC (µg l^{-1})		-	-	-

Health issues

Specific human health issues	<table><tr><th>Carcinogen</th><th>Genotoxic</th><th>Endocrine disruptor</th></tr><tr><td>?</td><td>A3; B0; C0; D0; E2</td><td>?</td></tr><tr><th>Reproduction / development effects</th><th>Acetyl cholinesterase inhibitor</th><th>Neurotoxicant</th></tr><tr><td>✓</td><td>X</td><td>X</td></tr><tr><th>Respiratory tract irritant</th><th>Skin irritant</th><th>Skin sensitiser</th></tr><tr><td>✓</td><td>X</td><td>No data found</td></tr><tr><th>Eye irritant</th><th>Phototoxicant</th><td></td></tr><tr><td>X</td><td>No data found</td><td></td></tr></table>
General human health issues	May cause pulmanary problems Possible liver, adrenals, testes, postrate & spleen toxicant Hepatotoxic in mice USEPA - probable human carcinogen Endocrine issues - Increase weakly aromatase activity

Handling issues

Property	Value and interpretation
General	Prevent generation of mists IMDG Transport Code is usually 9 Not explosive or oxidising
CLP classification 2013	Health: H351 Environment: H400, H410
EC Risk Classification	Carcinogen category 3: R40 N - Dangerous for the environment: R50, R53
EC Safety Classification	S2, S36/37, S60, S61
WHO Classification	III (Slightly hazardous)
UN Number	Variable with product, usually 3077 or 3082
Waste disposal & packaging	Packaging Group III (minor danger)

TRANSLATIONS

Language	Name
English	iprodione
French	iprodione
German	Iprodion
Danish	iprodion
Italian	iprodione
Spanish	iprodiona
Greek	iprodione
Polish	iprodion
Swedish	iprodion
Hungarian	iprodion

Language	Name
Dutch	iprodion

Record last updated: 11/11/2019

Contact: aeru@herts.ac.uk

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IPRODIONE JMPR 1977

IDENTITY

Iprodione is a recommended common name of APTOR and BSI and a proposed ISO Standard Common Name.

Chemical name

3-(3,5-dichlorophenyl)-N-isopropyl-2,4-dioxoimidazolidine-1-carboxamide

Chemical abstracts

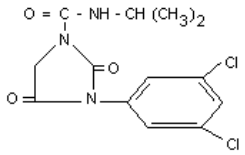
1-(1-methylethylaminocarbonyl)-3-(3,5-diohlorophenylimidazolidine)-2,4-dione

i-isopropylcarbamoyl-3-(3,5-dichlorophenyl)hydantoin

Synonyms

Glycophene, promidione, 26019 RP, ROP, 500 F., NRR 910, LPA 2043
Rovral (R)

Structural formula



$C_{13}H_{13}N_3O_3Cl_2$

Other Information on Identity and Properties

a) Composition of the technical product

The technical product contains 95% minimum of iprodione. The main impurities are phenyl hydantoins and bis-isopropyl-1,,3\-urea (referred to as 32870 R.P.).

b) Physical and chemical properties

Physical state: white, odourless, non-hygroscopic crystals.
Molecular weight: 330.17
Melting point: 136°C
Volatility: not volatile
Vapour Pressure: 2×10^{-7}mm. Hg at 20°C

Solubility at 20°C: g/l

water	0.013
ethanol	30
acetonitrile	150
toluene	150
benzene	200
acetone	300
methlyene chloride	500

Formulations

Mainly wettable powder 500 g a.i./kg. Also suspension concentrate 500 g a.i./l and emulsifiable concentrate 200 g a.i./l.

EVALUATION FOR ACCEPTABLE DAILY INTAKE

BIOCHEMICAL ASPECTS

Single oral doses of iprodione are rapidly eliminated by rats.

Following a single application of an oral dose of 200 mg/kg, 26% of the administered dose was eliminated in the urine and 59% in the faeces within 24 hours after application. The major part of the dose excreted in the faeces is the parent compound, whereas only 3% of the administered dose is eliminated unchanged in the urine. Besides the principal urinary metabolites with a degraded isopropylcarbamoyl group (about 11% of the dose administered), there are metabolites with intact hydroxylated or non-hydroxylated aromatic rings. The isomer of the parent compound accounted for a small proportion of the

metabolites. Residues in the principal organs and tissues did not exceed 1.5% of the administered dose in rats sacrificed 4 days after dosage (Laurent and Bays, 1974).

In a similar study rats were dosed once with 100 mg/kg. of ^{14}C-aromatic ring-labelled iprodione; 96 hours after administration 62% of the applied dose was eliminated via the urine and 36% via the faeces. About 16% was excreted as the parent compound in the faeces: the remaining radioactivity was mainly in urine in the form of the desisopropylated derivative (about 20% of the dose) and the N-(3,5-diachloro-4-hydroxyphenylbiuret) (approx. 13%). Tissues sampled

4 days after dosage contained about 1% of the administered dose. (Lourer, et al., 1976),

Based on the identified metabolites the reactions that seem to occur during biotransformation are mainly hydroxylation, oxidation and desalyklation of the isopropylcarbamoyl group ($-N_1$-CO-NH-CH$(CH_3)_2$->N_1-CO-NH_2->N_1-H).

TOXICOLOGICAL STUDIES

Special studies on teratogenicity

Groups of 25-30 rats were orally treated with 0, 100, 200 and 400 mg/kg on Restation days 5 to 15. Females at 400 mg/kg showed reduced fertility, reduced body weight gain and a dose-related reduction of food consumption especially during the treatment period. The number of implantations was also reduced at the highest dose level.

There was no indication for an embryonyic or teratogenic effect of the test completed (Coquet, 1973a).

Groups of 15-17 New Zealand White rabbits were intubated on gestation days 6-16 inclusive with 0, 100, 200 or 400 mg/kg. Body weight gain, over the period of treatment, was slightly reduced at 100 mg/kg, and a dose-related weight loss occurred at 200 and 400 mg/kg. Food intake was reduced at 200 mg/kg and above. At 400 mg/kg, 9 of 17 females died, and only one of the four remaining pregnant animals carried to term. Foetal loss was increased at 200 mg/kg, and foetal weight was reduced at 200 mg/kg and above. Multiple malformations occurred in 1 of 68 living foetuses at 200 mg/kg. Minor malformations were noted in all groups.

Special studies on carcinogenicity

See "Long term studies."

Special study on reproduction

Groups of 10 male and 20 female rats were maintained on a diet containing iprodione at concentrations of 0, 125, 250 and 1000 ppm for the first 5 weeks of each generation and 0, 250, 500 and 2000 ppm for the next 8 weeks of treatment. The diet was fed through three generations. The treatment did not affect the growth rate, food consumption, mortality or fertility of the parental animals. The number of living delivered pups of the females treated with 2000 ppm was slightly reduced and the post-natal growth of the pups was slightly retarded. There was also a tendency for growth reduction at 500 ppm. Autopsy findings and microscopic examination of the major organs performed in rate of the third generation did not reveal abnormalities. (Coquet, 1976)

Special study on mutagenicity

Groups of 25 male mice were fed 0, 1500 and 6000 ppm iprodione for 49 days. After termination of the feeding period the male mice were paired with 2 untreated females for 6 days, followed by a further 2 females for the 6-12 days post-treatment period. The treatment did not affect body weight, food consumption or fertility of the males. None of the examined parameters gave any indication of a mutagenic effect of iprodione (Hastings et al., 1974).

Iprodione showed no mutagenic action in a rec-assay using two strains of Bacillus subtilis, reverse mutation tests with and without liner activation system using E. coli WP2 hcr- and five strains of Salmonella typhimurium TA and host-mediated assay with S. typimurium G 46 in mice (Shirasu et al., 1976).

Acute Toxicity

TABLE 1. Acute toxicity of iprodione

Species	Sex	Route	LD_{50} mg/kg	References
Rat	M F	Oral	>2000	Pasquet & Mazuret, 1973

Rat	M F	Dermal	>2500	ibid.
Rat	M	i.p.	2400	Pasquet &. Mazuret, 1974
	F	i.p.	1200	ibid.
Mouse	M F	Oral approx.	4000	Pasquet A Mazuret, 1973
Dog	M F	Oral	>2000	ibid.
Rabbit	M F	Dermal	>1000	ibid.

The signs of toxicity were: loss of reflexes, muscular hypotonia, sedation and dyspena.

Iprodione did not cause skin or eye-irritation in rabbits.

In the anaesthetized dog iprodione administered at a dose of 300 mg/kg by the intraduodenal route did not affect the cardiovascular, respiratory or neurovegetative system (Detaille et al., 1973).

TABLE 2. Acute toxicity of a 50% formulation of iprodione

Species	Sex	Route	LD50 mg/kg	References
Rat	M F	Oral	8000	Davies & Lowe, 1974
	M F	Dermal	>2000	ibid.
	M F	4 h inhalation	13 mg/l air	Pasquet & Mazuret, 1975a
	M F	Oral	4100	ibid.
		Oral	4900	ibid.
	M F	4 h inhalation	>13/l air	Ibid.
Rabbit	M F	Dermal	>2000*)	ibid.

*) atoxic

The formulation induced slight irritation in the rabbit eye but had no irritant effect on the intact or abraded skin of rabbits (Pasquet & Mazuret, 1975a).

"In the sensitization test with guinea pigs, after 10 applications of 0-3 ml of a 50% iprodione solution, followed 2 weeks later by a challenge application, no evidence of dermal sensitization was observed" (Pasquet & Mazuret, 1975b).

Short term studies

Rat

Groups of 15 male and 15 female caesarian originated, barrier sustained, rats were fed 0, 150, 500 or 1000 ppm iprodione in the diet for 5 months. No effects were observed on mortality, food consumption, haematology (as judged by haemoglobin, haematocrit, erythrocyte count,

or total and differential leucocyte count) clinical chemistry (as judged by BSP, SGOT, SGPT or SAP) or urinalysis. Body weight gain was slightly reduced (especially in males) at 500 and 1000 ppm. Absolute (but not relative) heart weight was reduced in males at 500 and 1000 ppm, and absolute kidney weight was reduced at 1000 ppm. In females, absolute liver and kidney weights were significantly reduced at 500 ppm only. Gross and histopathology were normal at all dose levels. In a parallel study, dichlozoline, a structurally related compound, induced cataracts. No such effect was seen with (Ganter et al., 1973a).

Dog

Groups of 2 male and 2 female dogs were maintained on a diet containing iprodione at dose levels of 0, 800, 2400 and 7200 ppm for a period of 3 months. At the top dose level the method of administration was altered after 6 weeks, to gelatine capsules. The treatment did not affect mortality. The recorded values of haematological determinations and urinalyses were within normal limits. As judged by haemoglobin, haematocrit, reticulocyte erythrocyte count, total and differential leucocyte count and prothrombine time except for signs of mild anemia in 1 male and 1 female at 2 months and 1 male at 3 months at the top

dose level. At 7200 ppm a reduction of food consumption was observed, accompanied by reduced body weight gain. The opththalmosopic examination of the animals did not reveal any pathological alteration (Canter and Girard, 1973b). The clinical chemistry determinations consisted of glucose, urea, cholesterol, bilirubiu, total proteins, protein electrophoresis, alkaline phosphatase, SGOT, SGPT, LDH, Na^{+}, C, K^{+}, Cl^{-}, Ca^{++}, P. At 2400 and 7200 ppm a slight increase of SLP was observed, also a transient increase of SGOT and SGPT after 1 and 2 months of treatment at 7200 ppm. In treated male rats a dose-dependent increase of relative liver weights was observed, in females at the dose levels of 2400 ppm and above. At 7200 ppm reduced relative weight of testes was found, but no histological indication of damage.

The histopathological findings did not reveal any indication of treatment-related alterations of tissues (Coquet, 1973c).

Long term studies

Mouse

Groups of 60 male and 60 female mice were maintained an a diet containing the test compound at 0, 200, 500 and 1250 PPM for 18 months. No treatment-related effect on body weight, food consumption or mortality was found. The recorded values of the haematological blood chemistry and urinalyses tests performed after 6, 12 and 18 months of the feeding period, were within the physiological range. Necropsy findings on mice that died during the last 6 months of the test and on those sacrificed at the termination date showed an increased number of enlarged lymph nodes in males at 200 ppm. Organ weight variations occurred sporadically in the various dose groups and are considered not to be treatment-related. The histopathological findings failed to reveal abnormal features. The distribution of

neoplastic and non-neoplastic findings did not appear to demonstrate any significant dose-dependence. The most common tumours were lymphosarcoma involving the spleen, lymph nodes and thymus (Hastings and Hullman, 1975).

Rat

Groups of 60 male and 60 female rats were maintained on a diet containing 0, 125, 250 and 1000 ppm for 24 months. Slight reduction in body weight gain was observed at 1000 ppm. This was accompanied by some reduction in food intake. The treatment had no effect on food consumption, mortality or values of the hematologic, blood chemistry and urinalyses determinations. Necropsy findings did not reveal any drug-related gross alteration. Variations in organ weight did not show a group distribution and seemed not to be related to drug administration. Histopathology did not indicate a treatment relationship of neoplastic and non-neoplastic findings. AT 24 months the most common tumours observed were pituitary adenomas and adenocarcinoma and fibroadenoma of the mammary glands (Hastings et al., 1976).

COMMENTS

Iprodione is readily absorbed and rapidly excreted mainly as metabolites with intact hydantoin-moiety. The compound was not teratogenic. In a 3-generation study in rats, there was a slight but statistically significant reduction in postnatal growth at 2000 ppm. This effect was only marginal at the lower dose of 500 ppm which is regarded as a no-adverse-effect-level. In a short-term study in dogs no major effect occurred up to 2400 ppm. Likewise long-term studies in mice and rats revealed no effects up to 1250 ppm. No ocular alterations were found in any study.

TOXICOLOGICAL EVALUATION

Level causing no toxicological effect

Mice: 1250 mg/kg in the diet, equivalent to 160 mg/kg bw
Rat: 500 mg/kg in the diet, equivalent to 25 mg/kg bw

ESTIMATE OF ACCEPTABLE DAILY INTAKE FOR HUMANS

0-0.3 mg/kg bw

USE PATTERN

Iprodione is used as a fungicide against a range of fungus diseases, including Botrytis in vines, black- and red currants, blackberries, raspberries and vegetables especially lettuce; Botrytis alii on onions; Rhizocotonia on seed potatoes; seed borne diseases on sugar beets (Phoma spp.) and cereals. It is also used against Botrytis and some other fungus diseases on ornamentals.

The compound is used as a foliar spray on several crops, as a post-harvest dip for fruit, for dipping seed-potatoes and as a seed-treatment on sugar beet and cereals.

The product is authorized for use on various crops in France, the

Federal Republic of Germany, Greece, the Netherlands and the United Kingdom. In several other countries the compound is used or included in testing programmes and it is in course of registration in many countries including Australia, New Zealand, Japan, USA, Canada, Israel, and several European countries.

Most of the recommended uses are summarized in Table 3. The information may not be complete since the use of the compound is expanding rapidly and more uses may be expected in the near future.

RESIDUES RESULTING FROM SUPERVISED TRIALS

Extensive data were obtained from supervised trials carried out in various countries on fruit and vegetables and on some agricultural crops; they are summarized in Tables 4 to 8 and 10.

Pome and stone fruits (Tables 4 and 5; Rhône Poulenc, 1977a)

Apples

The residue at harvest from pre-harvest treatments at normal application rates (about 2.25 kg a.i./ha) is about 2 mg/kg. A combination of such treatments with post-harvest dipping gives rise to residues of about 6 mg/kg. After repeated applications at about twice the normal rate residues ranged from 2.9 - 6.5 mg/kg. The residue of the metabolite RB 30228 (see "Fate of residues") was below 0.15 mg/kg in these experiments.

Pears

Post-harvest dipping of pears against storage diseases gave rise to residues of 3.6 - 5 mg/kg.

Peaches

Residues at harvest following applications at the recommended rate varied between 0.9 and 6 mg/kg. A post-harvest dip adds about 4 mg/kg to these levels.

Plums

Residues arising from recommended applications varied between 0.6 and 6.8 mg/kg, depending on the pre-harvest intervals observed and the local conditions. The drying process increased the residue in the prunes by 0.6 - 1.6 mg/kg.

TABLE 3. Use pattern and recommended pre-harvest intervals of iprodione

Crop	Disease	Application		Pre-harvest intervals	
		No. of treatments	Rate g a.i./ha	Country	Days
Grapes	Botrytis	4	750	Austria	28
	"	4	750	France.	15
	"	4-5	750	Fed. Rep. of Germany	28
	"	3	3000	Japan	7
	"	4	750	Portugal	15
	"	4	750	Spain	15
	"	4	750	Switzerland	
	"	4	750	USSR	
	"	4	750	Yugoslavia	
Strawberries	Botrytis	4-5	1000	Belgium	15
		3	1000	Fed. Rep. of Germany	7
		3		Japan	1
		4-5	1000	The Netherlands	14
Pome and Stone fruit					
Apples	Alternaria	about 10		Japan	10
Peaches	Monilia	3		Japan	1
Vegetables					
Chicory (witloof) (forcing)	Botrytis	1	3 g/m^2	Belgium	Throughout the forcing period
	Sclerotinia	1 applied on the top of the roots at forcing	4 g/m^2	France	

TABLE 3. (Continued)

Crop	Disease	Application		Pre-harvest intervals	

		No. of treatments	Rate g a.i./ha	Country	Days
Cucumbers	Botrytis	4		Japan	1
Lettuce	Botrytis Scleotinia	3	750	Belgium	10 (glasshouse)
	"	3-4	750	France	
	"	3	750	Fed. Rep. of Germany	21 (glasshouse) 14 (outdoors)
	"	4	750	Japan	14
(also for endive)	"	1x	1000-2000	The Netherlands	28
	"	2xx	750	The Netherlands	28
Vegetables					
Onions	Botrytis Sclerotinia cepivorum	3	750	Japan	7
Tomatoes	Botrytis Alternaria	4		Japan United Kingdom	1
Agricultural Crops					
Beans	Sclerotinia	3		Japan	21
Rice	Pellicularia	3		Japan	21

TABLE 3. (Continued)

Seed and tuber treatments

Cereal seed

Crop	Disease	Application			Pre-harvest intervals
		No. of treatments	Rate g a.i./ha	Country	Days
Barley	Helminthosporium	1	60 g a.i./100 kg seed		
Wheat	Tilletia caries	1	60 g a.i./100 kg seed		
Garlic	Sclerotinia cepivorum	1	300 g a.i./100 kg seed	France	
Potatoes	Rhizoctonia solani	1	100-150 g/ 1000 kg tubers spraying on tubers immediately before storage dipping in spring before planting 400 g/100 l	France	
Sugar-beet seed	Phoma spp	1	150 g a.i./kg enveloped seed	France.	

x= one application at planting.
xx= two applications, the first about a week after planting and a second within two weeks after planting

Berry fruits and currents (Table 6; Rhône-Poulenc, 1977b)

The residue levels at harvest after treatments at normal rates and observing recommended pre-harvest intervals (10-21 days) were generally at or below 5 mg/kg on blackcurrants, 2 mg/kg on raspberries and 6 mg/kg on strawberries.

Grapes

The maximum residues of iprodione on grapes at harvest following treatment according to good agricultural practice (about 750 g a.i./ha) were in general not higher than 10 mg/kg. The highest levels in the unfermented must and the win were 4.4 and 6.4 mg/l respectively. Some results are shown in Table 10 (Rhône-Poulenc, 1977c). See "Fate of residues", "In storage and processing".

Vegetables (Table 7; Rhône-Poulenc, 1977d)

Chicory (witloof)

The residues in the edible sprouts after a normal period of forcing and one treatment at the recommended rate did not exceed 1 mg/kg. The residues in the roots were much higher, with a maximum of about 10 mg/kg. The roots are often used as animal feed.

Cucumbers

Residues on cucumbers treated with 3 kg a.i./ha (twice the normal rate) were between 0.3 and 2.2 mg/kg.

Lettuce

Residues arising from recommended applications on outdoor lettuce (750 g a.i./ha) varied between 1.7 and 2.5 mg/kg after pro-harvest intervals of 14-21 days. The residues on glasshouse-grown lettuce are in general much higher. Three applications of the recommended dosage gave rise to residues of 6.7 mg/kg after a pre-harvest interval of 39 days, and in other experiments maximum levels of 7.2 mg/kg were found 14 days after the last application. Residue levels of the metabolite RP 30228 were slightly about the limit of determination; other metabolites were below it. (Metabolites are identified in the section "Fate of residues."

Onions

The residues on onions 1 day after application did not exceed 0.2 mg/kg.

TABLE 4. Supervised trials of iprodione. Residues in pome and stone fruit (pre-harvest application)

			Application				Residues (mg/kg) at intervals (days) often application						
Crop	Country	Year	No	Rate g/100	Rate 1 kg/ha	Formulation*	0-2	3-6	7-10	13-14 (20-22)	30-35	40	50
Apples	Japan	1975	1	100	5	WP 50%		2.15	1.75				
		1975	1	100	5	"		2.9	2.25				
		1975	1	100	5	"			0.38				
		1975	10	100	5	"			6.5				
		1975	10	100	5	"				(5.75)			
		1975	10	100	5	"					3.75		
		1975	10	100	5	"			3.4				
		1975	10	100		"				(1.95)			
		1975	10	100	5	"					1.7		
	U.K.	1975	10	100	2.25	"				(2.0)			
Cherries													
Moss	Australia	1975	4		1.4	"		8.0					
Peaches													
Katharine	Australia	1976	7	50	1.4	"		5.4					
Anne Truly		1976	3	50	0.5	"		1.7					
Goldmine		1976	5	50	1.4	"		5.8					
Redhaven	Canada	1974	4	50	1.0	"	6.5	4.6	4.9				
		1974	4	50	1.0	"						1.45	
Babygold	Canada	1974	7	50	1.0	"	2.3	2.0	1.3				
		1974	6	50	1.0	"			1.8		0.9		
Earlired		1974	5		1.0	"	2.5	1.9	2.2	2.2			
Redhaven		1974	5		1.0	"	6.1	4.1	3.4	2.9	1.6		
Sunhaven			5		1.0	"	7.6	9.0	10.0	8.5			
Gifu	Japan	1975	7	100	4.0		3.7	2.1					
		1975	3	100	4.0	"	4.6	2.9					
Okayama		1975	2	100	3.0	"	6.3	4.8					
		1975	3	100	3.0	"	6.8	5.8					

TABLE 4. (Continued)

			Application				Residues (mg/kg) at intervals (days) often application						
Crop	Country	Year	No	Rate g/100	Rate 1 kg/ha	Formulation*	0-2	3-6	7-10	13-14 (20-22)	30-35	40	50
Plums													
October purple	Australia	1976	4		1.4	"			2.2				
Inra 711	France	1973	4		0.5	SC					0.25	0.26	
			4		1.0	SC					1.4	0.9	
		1974			0.5					4.15			
			3		1.0					6.8			
			2		0.5								0.2
			2		1.0								0.6

* SC = Suspension concentrate
  WP = Wettable powder

TABLE 5. Supervised trials of iprodione. Residues in pome and stone fruit (post-harvest application)

Crop	Country	Year	Application No.	Rate g a.i./100 dip	Formulation	Residues (mg/kg) after storage period of (days) 1-2	7	11	85	95
Apples										
Cox's	U.K.	1973	-		-	2.0				
			1	200		5.8				
			1	200		4.4				
Pears										
Conference	U.K.	1973	1	200	SC	5.0				
		1973	1	200					4.8	
		1973	1	200					3.6	
		1973	1	200						4.7
		1973	1	200						
		1973	1	200				4.0		
Peaches	Australia		-		WP50%	1.7				
			1	50	WP50%	5.3				
			1	50	WP50%		5.0			

TABLE 6. Supervised trials of iprodione. Residues in berry fruits and currants

Crop	Country	Year	Application No.	Rate g/100 1 kg/ha	Formulation	Residues (mg/kg) at intervals (days) after application 0-1	3-4	7-10	13-17	18-23	28-30	33-36
Raspberries	France	1974	3	0.8	WP 50%					1.1		
Heyton				0.5						0.85		
Malling jewel	U.K.	1974	5	1.1	" "				1.55			
			3	1.1	" "				2.0			
			4	1.1	" "	7.9	5.0	2.8	2.1			
Strawberries	Belgium	1974	5	0.75	" "				4.9			
Sivetta			5	1.0	" "				6.0			
Domunil			5	0.75	" "				1.9			
			5	1.0	" "				2.5			
Redcoat	Canada	1974	4	1.	" "	3.1	1.8	1.4	0.85			
Vista			4	1.1	" "	3.5	2.4	1.4	1.0			
Redcoat			4			3.45	2.1	1.6	1.0			
Redcoat			3						0.9	0.8	0.2	
Red Gauntlet	France	1973	4	0.5	" "				0.22			
				0.75	" "				0.44			
				1.0	" "				0.66			
Immigrante		1974	4	0.75	" "					1.75		
			4	1.0	" "					2.2		
Gorella		1974	4	0.75	" "			0.35				
			4	1.0				0.44				
			3	0.75	" "							0.5
			3	1.0	" "							1.1
Suprême d'Halles			4	0.5	" "				1.2			
			4	0.75	" "				1.9			
			4	1.0	" "				2.75			
			4	0.5	" "				2.5			
			4	0.75	" "				3.2			
			4	1					5.6			
Senga Segana	Fed. Rep. of Gemany	1974	3	0.9	" "	5.3	2.7	2.3	1.0	0.4		
			3	1.25	" "	9.1	3.6	3.4	1.9	0.7		

TABLE 6. (Continued)

Crop	Country	Year	Application No.	Rate g/100 1 kg/ha	Formulation	Residues (mg/kg) at intervals (days) after application 0-1	3-4	7-10	13-17	18-23	28-30	33-36
Senga Segana	Netherlands	1974	4	0.75	" "					1.1		
		1974	5	0.75	" "	26.4		14.2	0.67			
Red Gauntlet	Switzerland	1974	1	0.75	" "	1.0	0.86	0.2	0.1	0.1		
Wädenswill		1974	3	0.75	" "					0.2		

		1974	3	0.75	" "					0.15			
Royal Sovereign	U.K.	1974	4	1.1	" "	1.2	1.6	1.3					
Strawberries													
Cambridge Favourite (g)		1974	4	1.1	WP 50%	8.0	6.9	4.5	4.7				
Cambridge Favourite (g)		1974	3	1.1	" "								1.7
Cambridge Favourite		1974	3	1.0	" "					0.7			
Cambridge Favourite		1976	3					1.6	1.1				
Cambridge Favourite		1976	3	0.75				0.9	0.6				
Red Gauntlet		1976	1	0.75					0.6				
Red Gauntlet		1976	1	1.0					0.9				
Red Gauntlet		1974	3	2.2									1.7
Cambridge Favourite		1974	3	2.2						0.55			
Royal Sovereign		1974	2	1.0							0.3		

TABLE 6. (Continued)

Crop	Country	Application Year	No.	Rate g/100 1 kg/ha	Formulation	Residues (mg/kg) at intervals (days) after application 0-1	3-4	7-10	13-17	18-23	28-30	33-36
Black currants												
Wellington Tr.	UK	1974	4	1.1	WP 50%							3.9 62 days
Baldwin	UK	1974	4	1.1	" "							4.6 62 days

(g) = glasshouse

TABLE 7. Supervised trials of iprodione. Residues in vegetables

Crop	Country	Year	Application No.	Rate 1kg/ha g/100	Formulation	Residues (mg/kg) at interval (days) after application 0-1	3-4	5-7	10-14	21-22	28-30	31-35
Bean without pod	Japan	1975	1	1	WP 50%				0.05	0.05	0.05	
Cucumbers(g)	Japan	1975	3	1						0.05	0.05	
		1975	1	3	WP 50%	1.7	1.0	0.36				
		1975	3	3	" "	1.6	0.9	0.7				
		1975	4	3	" "	2.2	1.4	1.2				
		1975	1	2.5	" "	1.2	1.0	0.24				
		1975	3	2.5	" "	1.9	1.4	0.3				
		1975	4	2.5	" "	1.8	1.0	1.0				
Lettuce												
Val.d'Orge	France	1974	6	0.5	" "							0.03
			6	0.75	" "							0.03
			6	1.0	" "							0.03
			6	0.5	EC 200g/l							<0.02
			6	0.75	" "							<0.02
			6	1.0	" "							0.04
			5	0.5	WP 50%					2.5		
			5	0.75	" "					1.3		
Murkönig	Fed. Rep.		3	0.75	" "	15.7		1.8	0.6	0.05	0.05	0.05
Kares	of Germany	1976	4	0.75	" "	24.5		9.1	1.7			
Reskia		1976	3	0.25	" "	2.6		0.8	0.2			
			3	0.75	" "	13.2		3.0	1.1			
Susan		1976	3	0.5	" "	4.6		1.2	0.4			
			3	0.75	" "	28		4.3	4.2			
Murkönig(g)	Fed. Rep. of Germany	1976	3	0.25	" "	24		6.9	2.9			
			3	0.75	" "	46		10.5	7.2			

TABLE 7. (Continued)

			Application Rate			Residues (mg/kg) at interval (days) after application						

Crop	Country	Year	No.	1kg/ha g/100	Formulation	0-1	3-4	5-7	10-14	21-22	28-30	31-35
Ravel(g)		1976	3	0.25	" "	26		5.4	2.7			
				0.75	" "	22		4.8	3.6			
Kurume Br.(g)	Japan	1975	2	3	" "			4.6	0.28	0.05		
			3	3	" "			10.8	0.27	0.1		
			4	3	" "			7.4	0.3	0.1		
Kumamoto(g)	Japan	1975	2	1.5	" "			0.48	1.05	0.4		
			3	1.5	" "			1.9	0.6	1.2		
			4	1.5	" "			2.25	0.78	1.7		
Déciminor(g)	Netherlands	1975	2	0.75	" "					8.2	4.9	
Vera(g)		1975	2	0.75	" "				9.15	0.05		0.05
Ostinata(g)	UK	1974	4	0.56	" "	19	18	14		(24 days)		
Val d'Orge		1974	3	0.56	" "					8.8		
			4	0.56	" "	59	40	41	21			
Onions	S. Africa	1977	7	50	WP 50%	0.14 0.15						
				100	" "	0.15 0.24						
Sweet Peppers(g)	U.K.	1975	6					4.3				

TABLE 7. (Continued)

Crop	Country	Year	Application Rate No.	1kg/ha g/100	Formulation	Residues (mg/kg) at interval (days) after application 0-1	3-4	5-7	10-14	21-22	28-30	31-35
Tomatoes												
Koibuchi (g)	Japan	1975	1	2.5	" "	1.25	1.4	1.2	0.8			
Koibuchi (g)		1975	3	2.5	" "	5.3	3.4	3.0	2.4			
Koibuchi (g)		1975	4	2.5	" "	5.6	5.4	4.3	3.5			
		1975	3	3.0	" "	2.1	3.3	1.8	2.9			
			4	3.0	" "	4.6	3.6	4.1	2.8			
			5	3.0	" "	4.4	4.0	3.8	3.7			
Eurocross(g)	U.K.	1974	5	50	" "				2.7			
			6	50	" "				3.8			
			7	50	" "				4.9			
			8	50	" "				4.2		2.3	
Sonato(g)	U.K.	1974	4	50	" "				1.65			
			5	50	" "				2.3			
			6	50	" "				2.8			
			7	50	" "				3.7			
			8	50	" "				4.2		5.8	
			5	50	" "	3.1		2.5	2.7			
			1	1	" "					0.64 (18 days)		

TABLE 7. (Continued)

Crop	Country	Year	Application Rate No.	a.i. g/m2	Formulation	Residues (mg/kg) at interval (days) after application 30-40 S	R	40 S	R	44-48 S	R	59 S	R	70 S	R	93-104 S	R	162 S	R
Chicory	Belgium	1975	1	3	" "					0.41	1.49								
			1	6	" "					0.36	3.10								
				3	" "							0.09	2.7						
				6	" "							0.32	4.4						
				3	" "											0.77	6.2		
				6	" "											0.59	10.0		
				3	" "											0.55	2.7		
				6												1.0	3.7		
	France	1974	1	4	" "			0.6											
				8	" "			1.0		0.07									
				4	" "					0.25									
				8	" "														

TABLE 7B

Crop	Country	Year	No.	Rate g/100 dip	1g/1000 kg	Formulation	30-40 S	R	40 S	R	44-48 S	R	59 S	R	70 S	R	93-104 S	R	162 S	R

Potatoes

pre-plant treatment	France	1976	1	200		WP 50%						n.d.
				300		" "						n.d.
					50	" "						0.01
					100	" "						0.01
					150	" "						0.02
				200		" "		3.0			5.0	
					50	" "		25			25	
					100	" "		58			67	
					150	" "		120			140	
foliar spray	S. Africa	1976	5	50		" "	<0.02					
			5	100		" "	<0.02					
			3	50		" "			<0.02			
			3	100					<0.02			

WP = wettable povider; EC = emulsion concentrate;
(g) = glasshouse; R = roots (chicory) or tubers (potato); S=sprouts

Peppers and tomatoes

Following applications at normal rates (50 g a.i./100 l) residues of 4.5 - 5 mg/kg were found at harvest after pre-harvest intervals of 3.6 days.

Beans (dry)

After treatment at a dosage rate of 1 kg/a.i./ha, residues in the dry beans were very low (0.05 - 0.2 mg/kg).

Cereal crops (Table 8; Rhône-Poulenc, 1977e)

Wheat

Two applications at normal rates (1 kg a.i./ha) with a pre-harvest interval of 73 days did not give rise to measurable residues in the kernels.

Rice

After treatment during the growing season with relatively high dosages (1.2 kg a.i./ha), residues of 0.1 - 2.1 mg/kg were found de-husked, unpolished rise 21 days after the last treatment.

FATE OF RESIDUES

In plants

The fate of iprodione in plants and soil was studied with unlabelled and ^{14}C-phenyl-labelled products. It was found that when applied to the leaf surface, iprodione does not appreciably penetrate through the skin. The residues on the skin had a half-life of 30-60 days, being slowly converted to 1-(3,5-dichlorophenylcarbamoyl)-3-isopropylhydentoin, RP 30228), which represented up to 35% of the remaining residue. 2-5% of this residue consisted of minor degradation products, including 1-carbamoyl-3-(3.5-dichlorophenyl) hydantoin (RD 32490) (Rhône-Poulenc, 1973).

Wheat and strawberry plants grown on soil treated with iprodione (Rhône-Poulenc, 1977f) took up small amounts of the compound (in wheat 0.7-1.3% of the amount applied to the soil surface), which was mainly found in the leaves and stems (95-99% of the extractable residue). Within the plant the parent compound was converted to RP 30228, small amounts of RP 32490 and some more polar unidentified products.

The organosoluble residue in strawberry plants 32 days after a foliar application at a rate equivalent to 1 kg a.i./ha consisted of 61% unchanged parent compound and 16% RP 30228. 55 days after foliar treatment at 2 kg a.i./ha 69% of the residue was iprodione, 7% RP 30228 and 5% RP 32490.

TABLE 8. Supervised trials of iprodione. Residues in cereal crops.

			Application			Residues (mg/kg) at intervals (days) after application				
Crop	Country	Year	No.	Rate g/100 l kg/ha	Formulation	14-15	21-22	28-30	73	81
Rice grain	Japan	1975	1	100 1.2	WP 50%	0.1	0.1	0.1		

straw							16	15	10.3		
	1975	1	100	1.2	WP 50%						
grain							0.3	0.4	0.3		
straw							32	12.5	10.5		
		3	100	1.2	WP 50%						
grain								2.1			
straw								45			
		3	100	1.2	WP 50%						
grain									1.4		
straw									32		
		3	100	1.2							
grain								0.8			
straw								49			
		4	100	1.2				1.8			
grain								43			
straw											
Wheat											
Maris											
Nimrod	UK	1	34	1.0						<0.05	
		2	34	1.0						<0.05	
Jos Cumbier		1	34	1.0							<0.05
		2	34	1.0							<0.05

TABLE 9. Nature and Distribution of radio-activity in wheat grown in soil treated with 10 kg/ha. ^{14}C-iprodione

		% of total ^{14}C in each plant part as						
Days after treatment	Plant part	Iprodione	RP 30228	RP 32490	Organo-soluble	Unidentified Water soluble	Unidentified Bound	Total ^{14}C expressed as iprodione mg/kg
16	roots	49	14	n.d.	21	0	17	20
	leaves and stem	66	6.4	4.4	21	1.5	1.7	20
44	roots	16	15	n.d.	13	1.1	55	31
	leaves and stem	48	9.5	18	20	0.95	4.2	20
89	roots	2.9	8.1	0.8	9.2	0	79	238
	leaves and stem	26	17	14	32	0.22	11	36.7
	ears	9.1	3.1	0.1	24	0	56	32
	kernels	n.d.	n. d.	n.d.	72	0	28	2.5

Wheat plants were grown on soil treated with excessive dosages of ^{14}C-labelled iprodione and the distribution of the residue in the plant was studied after 16, 44 and 89 days. The nature and distribution of the recovered radio-activity is shown in Table 9 (Rhône-Poulenc, 1977f).

The plant and soil metabolites of iprodione have been identified by various methods including TLC, GLC, and colorimetric analysis and the degradation pathway shown in Figure 1 deduced.

In soil

The degradation of residues in soil follows a similar pattern. The half-life at initial levels of 2 and 5 mg/kg is about 30 days. After 12 months incubation under aerobic conditions at 23-25°C, no more than 3% of the remaining radio-activity was in the form of unchanged iprodione. Conversion to metabolite RP 30228 proceeded rapidly. The concentration of RP 30228 reached a maximum (45-55% of the radio-activity still present) after 80-100 days and then decreased (Rhône-Poulenc, 1976).

In leaching experiments with radio-labelled iprodione it was shown that the parent compound was only slightly mobile, remaining in the 0-15 cm layer. The metabolite RP 30228 is less soluble in water than the parent compound (0.5 mg/l compared to 13 mg/l) and virtually all remained in the 0-5 cm layer (Rhône-Poulenc 1973, 1976).

In storage and processing

Extensive data were obtained from various countries on the fate of residues of iprodione during wine making and on the effect of residues on the fermentation. When grapes containing about 5 mg/kg were used for wine making, no influence on the fermentation process was found. This was confirmed in laboratory experiments in which CO_2 evolution and the proportion of viable cells (those susceptible to actidione) were measured.

In a trial in which the grapes contained 2-10 mg/kg iprodione, the fermentation process was slightly retarded. It is unlikely that this effect would be observed under practical conditions of wine making.

During the wine making, iprodione remains fairly stable, but a considerable part of the residue will be eliminated with the solids (mavc) during clarification. The residues in wine are generally about 15-25% of those in the grapes. No residues of iprodione were found in alcohol obtained after distilling wine (Rhône-Poulenc, 1977c; Barre et al., 1976). Some results are shown in Table 10.

TABLE 10. Residues of iprodione at various stages of vinification

Country	Year	Grapes	Iprodione, mg/kg in Must		Wine		Finished Wine
			Unfermented	Fermented	Racked	Clarified	
France	1974	4.9	2.7	0.98		0.75	
		3.0	1.7	1.0			0.71-0.84
	1975	6.1	2.75		0.8		
		7.5	4.4		1.45		
	1975	2.2	1.5		0.34		
		5.4			0.6		
South Africa	1976	1.0	1.3				0.9
		2.6	0.5				1.5
Switzerland		2.3	1.9			0.7	
	1973	1.7	1.4			0.5	
		2.9	1.9			0.4	

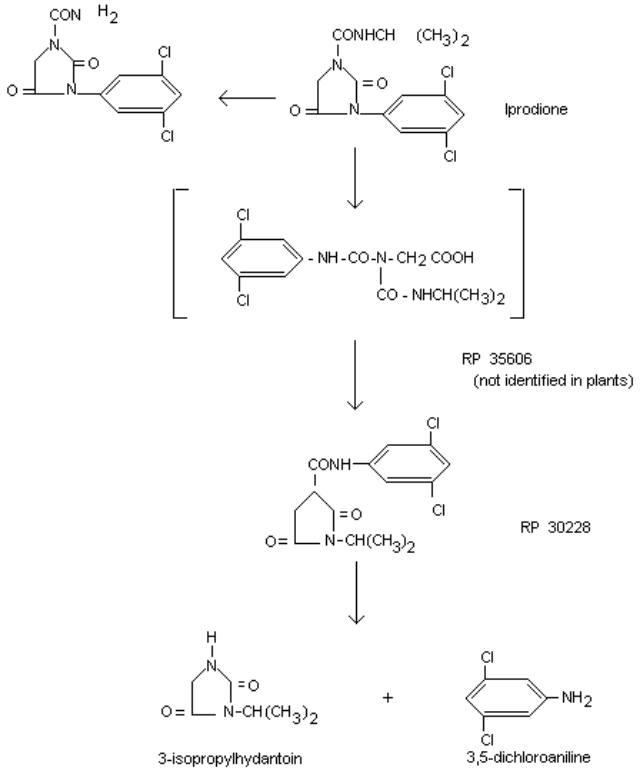


Figure 1. Degradation of iprodione in plants and soils (Rhone-Poulenc, 1973, 1976).

METHODS OF RESIDUE ANALYSIS

Gas-chromatographic methods using electron capture detectors have been developed for the analysis of residues in several fruits and vegetables. These are suitable or can be adapted for regulatory purposes. They have been adapted for residue analysis In must and wine. The limit of determination on most fruits and vegetables is about 0.01-0.02 mg/kg. Some commodities of plant origin, e.g. prunes and mare, require a more elaborate clean-up owing to the higher proportion of interfering plant constituents. The limit of determination in these commodities is about 0.05-0.1 mg/kg.

No loss of residues was found during storage for more than 1 year at temperatures of -18°C.(Rhône-Poulenc, 1975a,b).

NATIONAL TOLERANCES REPORTED TO THE MEETING

The following maximum residue limits were reported to the Meeting as established or under consideration. They refer to iprodione, excluding metabolites.

Country	Commodity	Maximum residue limit, mg/kg
Australia	Apricots, cherries, plumes peaches	10
France	Grapes	10
Fed. Rep. of Germany	Grapes	10
The Netherlands	Lettuce	5
	Strawberries	2
New Zealand	Apricots, berry fruits, cherries, grapes, peaches, plums	10
Switzerland	Grapes	7

APPRAISAL

Iprodione is used against a relatively broad range of fungus diseases, on a wide range of fruits and vegetables.

Its use is authorized, or is in course of registration, for various crops in a number of countries. It is marketed in the form of a wettable powder, a suspension concentrate and an emulsifiable concentrate. The products are mainly used as a spray on the aerial parts of growing crops, for post-harvest dipping of fruit as a dip for seed potatoes and as a seed treatment. Application rates vary according to the crop/disease situation and regional conditions. Residue data were obtained from supervised trials carried out in various countries with different climatic conditions. Studies with unlabelled and ^{14}C-phenyl-labelled products showed that iprodione does not appreciably penetrate through the plant cuticle. The residue on the surface of the plants had a half-life of about 30-60 days. It

was converted into 1-(3,5-dichlorophenyloarbamoyl)-3-isopropyl-2,4-dioxoimida-zolidine, 1-(3,5-dichlorophenylcarbamoyl)-3-isopropylhydantoin, RP 30228, which represented up to 35% of the remaining residue. 2-5% of this residue consisted of minor degradation products, including 1-carbamoyl-3-(3,5-dichlorophenyl)hyclantoin (RP 32490).

Wheat and strawberry plants grown on soil treated with iprodione took up small amounts of the compound (equivalent to 0.7-1.3% of the total applied to the soil surface). Within the plant the parent compound was converted into metabolite RP 30228, Small amounts of RP 32490 and some more polar unidentified products. The degradation of residues in soil follows the same pattern. The half-life at initial levels of 2 and 5 mg/kg is about 30 days. After 12 months incubation under aerobic conditions at 23-25°C no more than 3% of the remaining residue is in the form of unchanged iprodione. The parent compound is only slightly mobile, remaining mainly in the upper 0-15 cm layer. The metabolits RP 30228 is less soluble in water than the parent compound (0.5 mg/l compared to 13 mg/l) and virtually all remained in the 0-5 cm layer. Residues in wine were approximately 15-25% of those on the harvested grapes.

Gas-chromatographic methods using electron capture detectors have been developed for the analysis of residues in several fruits and vegetables, must and wine, which are suitable or can be adapted for regulatory purposes. The limit of determination is generally about 0.01-0.02 mg/kg. No loss of residue was found over more than 1 year at -18°C.

RECOMMENDATIONS

The following maximum residue limits for iprodione on various fruits and vegetables are recommended. They refer to iprodione, excluding any metabolites.

Commodity	Limit, mg/kg	pre-harvest interval on which

		recommendations are based	post-harvest treatment
Apples, pears	10	10-14	+
Grapes	10	14-21	
Lettuce	10	14-21(28[1])	
Peaches	10	10-14	+
Plums	7	14	
Strawberries	7	14	
Blackcurrants	5	10-21	
Cucumbers	5	3-6	
Sweet peppers	5	3-6	

Commodity	Limit, mg/kg	pre-harvest interval on which recommendations are based	post-harvest treatment
Raspberries	5	10-21	
Tomatoes	5	3-7	
Rice (hulled, unpolished)	3	21	
Chicory (witloof) sprouts	1	throughout forcing	
Beans, dry	0.2	14-21	
Garlic, onions	0.1	1	

[1] Glasshouse use.

FURTHER WORK OR INFORMATION

DESIRABLE

1. Information on the fate of iprodione residues in milk, meat and eggs when food wastes containing iprodione residues are used as components of animal feeds.

2. Residue data on grain and straw from supervised trials on cereal crops treated according to good agricultural practice.

3. Further information about the effects of processing and cooking on iprodione residues in a range of commodities.

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See Also:
- Toxicological Abbreviations
- Iprodione (Pesticide residues in food: 1980 evaluations)
- Iprodione (Pesticide residues in food: 1992 evaluations Part II Toxicology)
- Iprodione (Pesticide residues in food: 1995 evaluations Part II Toxicological & Environmental)

IPRODIONE (addendum)

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Explanation

Iprodione, a dicarboximide fungicide, was first evaluated in 1977, when an ADI of 0-0.3 mg/kg bw was allocated (Annex I, reference 28). The ADI was reduced to 0-0.2 mg/kg bw in 1992 on the basis of new data from a study of reproductive toxicity in rats, a study of teratogenicity in rabbits, and a one-year study of toxicity in dogs, and applying a safety factor of 100 (Annex I, reference 65). The results of two additional studies of long-term toxicity and carcinogenicity in rats and mice and studies of the mechanism of carcinogenesis have now become available. These results are summarized and discussed in this monograph addendum.

Evaluation for acceptable daily intake

Toxicological studies

(a) Long-term toxicity and carcinogenicity

Previous studies at dietary concentrations of 0, 200, 500, or 1250 ppm in mice and 0,125, 250, or 1000 ppm in rats revealed no evidence of tumorigenic activity in either species (Hastings & Huffmann, 1975; Hastings *et al.,* 1976). Two additional studies conducted at higher doses have become available.

Mice

Iprodione (purity, 95.7%) was fed in the diet at concentrations of 0, 160, 800, or 4000 ppm to groups of 50 male and 50 female Crl: DC-1 (ICR) Br mice for 99 weeks. Satellite groups of 15 animals of each sex received the same doses and were used for blood sampling, biochemical investigations, and interim sacrifice after one year of study. Dietary sampling conducted before the study confirmed the homogeneity and stability of the diet. Treatment caused no clinical signs of toxicity and no increase in mortality; haematological parameters were not affected. The group mean body-weight gain was no different in treated and untreated animals for the first 18 weeks, but after 45 weeks of treatment the body-weight gains of animals at 4000 ppm were lower than those of the controls, by 3% in females and 5% in males. The food consumption of females at this dose was slightly increased from week 19 to termination of the study. In clinical chemical examinations conducted during week 52 in 10 animals of each sex in the satellite groups, the only treatment-related changes were increased levels of aspartate and alanine aminotransferases in animals of each sex at 4000 ppm.

At interim sacrifice, changes in organ weights were seen in animals at the highest dose, including increased liver weights (adjusted for body weight by covariance analysis) in animals of each sex and increased adrenal weights (absolute) which were statistically significant only in males. Macroscopic changes observed in satellite animals included liver enlargement in both males and females at 4000 ppm and accentuated lobular markings in males at 800 and 4000 ppm and in females. Microscopic examination revealed various non-neo-

plastic findings in the liver, adrenals, ovaries, and testes of animals at the highest dose. In the liver, there was an increased incidence of hepatocellular enlargement in animals of each sex, and females in this group also had centrilobular hepatocyte vacuolation. The changes in the adrenals consisted of hypertrophy of the cells of the zona fasciculata in females. In testes, generalized vacuolation and hypertrophy of the interstitial cells were observed. In a number of females at the highest dose, luteinization of the interstitial cells of the ovary was noted. No treatment-related changes in tumour incidence were seen at the interim sacrifice.

At terminal sacrifice, an analysis of organ weights (for most organs, both adjusted and absolute weights were reported) revealed increased liver weights in animals of each sex at the highest dose. Slight increases in thyroid weights (statistically significant in males) and kidney weights (statistically significant in females) were seen, and females also had decreased uterine weights. Macroscopic examination revealed a higher incidence of liver masses in animals of each sex at 4000 ppm and in males at 800 ppm in comparison with the control animals, and liver enlargement was seen in male and female mice at 4000 ppm. Further macroscopic changes at 4000 ppm included a decrease in the incidence of thickened uteri in females and increased incidences of thickened forestomachs in animals of each sex. Kidneys with irregular cortical scarring and altered shape were observed at a higher incidence in females at 4000 ppm. The testes had a high incidence of masses, and there was an increased prevalence of small testes at 4000 ppm. Microscopic examination revealed increased incidences of benign and malignant liver tumours in animals of each sex at the highest dose; the incidences in males were 14, 12, 20, and 52% in the controls and in animals at 160, 800, and 4000 ppm, respectively, and those in females were 4, 4, 4, and 42%, respectively. The incidence in males at the highest dose clearly exceeded the historical incidence, reported to be 12-21%. In females, the historical control incidence was reported to be 0-2%. The liver tumour incidences in females in the control, 160-ppm, and 800-ppm groups were thus slightly higher than this range, and at the highest dose the incidence markedly exceeded it. The slight, non-dose-related increases in incidences observed in the concurrent controls and in animals at 160 and 800 ppm were not considered to be biologically relevant. When all four treatment groups were considered, the trend was significant, but when the highest dose was excluded from the analysis the trend was not significant. The ovaries of females at the highest dose showed an increased incidence of luteoma, with incidences of 0, 4, 2, and 10% at 0, 160, 800, and 4000 ppm, respectively. The historical control range was reported to be 0-8%. When all four groups were considered, the trend was significant, but when the group at the highest dose was excluded from the analysis it was not significant. No increased incidences were found of other tumour types, including testicular tumours.

Non-neoplastic findings at terminal sacrifice found in various organs in animals at 800 or 4000 ppm confirmed the observations made at the interim sacrifice. In the liver, an increased incidence of enlarged eosinophilic and fat-containing hepatocytes was observed in animals of each sex at the highest dose, and centrilobular hepatocyte enlargement was seen in females at 800 ppm and in animals of each sex at 4000 ppm; pigmented macrophages and centrilobular hepatocyte vacuolation were found in males at 4000 ppm. The testes of males at 800 and 4000 ppm showed an increased prevalence of generalized

vacuolation and hypertrophy of the interstitial cells. In females at 4000 ppm, luteinization, the absence of corpora lutea, and a decreased incidence of endometrial hyperplasia were reported. Males at the two higher doses showed hyperkeratosis of the non-glandular stomach. Haemosiderosis in the spleen, amyloidosis, and cortical scarring in the kidneys were reported in female mice at the highest dose. No treatment-related change in the adrenals was found at termination of the study. The NOAEL was 160 ppm, equal to 23 mg/kg bw per day in males and 27 mg/kg bw per day in females, based on microscopic changes, particularly in liver and testes at higher doses, and 800 ppm equal to 115 mg/kg bw per day in males and 138 mg/kg bw per day in females, for tumorigenicity in the liver and ovary (Chambers *et al.*, 1993).

Rats

Groups of 60 male and 60 female Crl:CD(SD)BR rats were fed diets containing iprodione (purity, 94.5-95.7%) at concentrations of 0, 150,

300, or 1600 ppm. Satellite groups consisting of 12 animals of each sex at each dose were used for blood sampling at various intervals and for interim sacrifice after 52 weeks of treatment. The homogeneity and stability of the test compound in the diet was checked by chemical analysis. The treatment did not result in clinical signs, no dose-related increase in mortality was observed, and the survival rate of animals at the highest dose was greater than that of the other groups. Ophthalmic, haematological, and biochemical investigations and urinalysis performed several times during and at the end of the study revealed no consistent treatment-related changes. The body-weight gain of animals of each sex at the highest dose was lower than that of controls during various periods of treatment, resulting in a 5% lower overall body weight at the end of the study in females and 10% in males. The food consumption of males was slightly lower throughout the treatment period and that of females during some weeks of the study.

At interim sacrifice, analysis of organ weights (for most organs, absolute, adjusted, and relative weights were reported) revealed a non-dose-related decrease in adrenal weights in females it all doses in comparison with controls. Since macroscopic examination revealed enlarged adrenals in females at 0, 150, and 300 ppm, the reduction in adrenal weights is probably due to an unusually high mean control value. Microscopic examination revealed a dose-related increase in the incidence of centrilobular hepatocyte enlargement at 300 and 1600 ppm in animals of each sex. Increased incidences of extramedullary haematopoiesis and haemosiderosis were seen in the spleens of females at the highest dose. All male and female rats at this dose showed enlargement of cells of the zona glomerulosa and vacuolation in the zona fasciculata and reticularis of the adrenals. No neoplastic findings were noted at interim sacrifice.

At terminal sacrifice, increased liver weights were seen in males at 300 and 1600 ppm, and the latter also had increased testicular weights. The macroscopic changes included masses in the testes at the highest dose, increased incidences of small seminal vesicles, irregular cortical scarring in the kidneys of males, petechiae in the lungs, and an increased incidence of uterine thickening. Microscopic examination did not confirm the hepatocellular enlargement observed at the interim sacrifice. A significantly increased incidence of interstitial-cell tumours in the testis (25%) was seen in animals at 1600 ppm; the incidence in the other groups was 5-12%, but with no clear dose-response relationship. The historical control range was reported to be 0-10%. Statistical analysis of the results revealed a highly significant trend when all four treatment groups were included.

Non-neoplastic changes seen in the testes of males at 300 and 1600 ppm consisted of an increased incidence of interstitial-cell hyperplasia. The authors reported that proliferative changes of the interstitial cells of the testis are age-related alterations which may have been associated with the increased survival of males at the highest dose. Further changes observed were atrophy of the seminiferous tubules, an increased incidence of reduced or absent spermatozoa, atrophy of the prostate, and reduced secretion or absence of secretory colloid in seminal vesicles, some of these changes occurring at $\geq$ 300 ppm. In the kidneys, there was a dose-related increase in the incidence of basophilic, dilated cortical tubules containing eosinophilic colloid at 300 and 1600 ppm. This lesion is reported to be present in the early stage of progressive glomerulonephrosis and is known as an age-related finding; the incidence was not dose-related. Changes in the adrenals similar to those observed at interim sacrifice were seen, including enlargement of the cells of the zona glomerulosa and vacuolation in the zona fasciculata and zona reticularis, in male rats at 1600 ppm and to a lesser degree at 300 ppm. In females at the highest dose, a higher incidence of focal enlargement of cells of the zona glomerulosa was found in some animals. The NOAEL was 150 ppm, equal to 6 mg/kg bw per day in males and 8 mg/kg bw per day in females, based on changes in liver weight and histopathological findings in the liver, kidneys, adrenals, testes, and accessory glands at higher doses, and 300 ppm, equal to 12 mg/kg bw per day, for tumorigenicity in testicular interstitial cells (Chambers *et al.,* 1992).

(b) Special studies

Mechanism of action

Androgen receptors were isolated from the ventral prostate of previously untreated rats and incubated with a fixed concentration of

a high-affinity radiolabelled standard ligand (tritiated methyl-trienolone) in the competitive binding assay *in vitro*. In this assay, increasing concentrations of the potential competitors (dihydrotestosterone, testosterone, flutamide, hydroxyflutamide,

iprodione, and seven iprodione metabolites) are added, leading to displacement of the radiolabelled ligand from the ligand-receptor complex. Free labelled ligand is then separated from the receptor-bound labeled ligand, which is quantified by scintillation counting. This allows calculation of the concentration of test substance that causes 50% displacement of the labelled ligand. The relative binding affinity (percentage of competitor in relation to standard concentrations at 50% displacement on the standard curve) is then calculated for each substance, making it possible to rank all of the substances tested. Flutamide was used as the reference compound because it and its metabolite hydroxyflutamide have known anti-androgenic activity, with relative binding affinities to the androgen receptor of 0.01% for flutamide and 0.16% for hydroxy-flutamide. As testosterone and dihydrotestosterone have relative binding affinities to prostatic tissue of 35 and 100%, respectively, flutamide and hydroxyflutamide are much less potent. Iprodione and most of its metabolites had relative binding affinities of < 0.001%, only one metabolite having a value of about 0.006%. The study therefore provided no strong evidence for competitive binding or inhibition of the androgen receptor by iprodione (Fail *et al.*, 1994).

Another study was performed to investigate the potential inhibitory effects of iprodione and its metabolites on steroidogenesis, using a cultured porcine Leydig-cell model to detect a potential inhibitory effect on testosterone secretion. The testosterone concentrations were determined in a radioimmunoassay. Iprodione and two of its metabolites inhibited gonadotropin-stimulated testosterone secretion after an incubation time of three days; the other iprodione metabolites tested had no detectable effects. Inhibition by iprodione was also observed after exposure for only 3 h. These results suggest a competitive interaction with the biosynthetic and/or transport pathway of steroid hormones. Ketoconazole, a known inhibitor of steroidogenesis, had similar effects. The inhibitory effect of iprodione was completely reversible after its withdrawal from the culture medium. The absence of cytotoxicity and the recovery of steroidogenesis strongly suggest interference with biochemical steps involved in testosterone secretion. The precise location of the biochemical lesions is being investigated (Benahmed, 1995).

Sex hormones were also measured *in vivo* in male rats after treatment with iprodione. In a range-finding study, groups of six or seven rats were treated twice daily at 12-h intervals by gavage with total daily doses of 0, 120, 300, or 600 mg/kg bw iprodione or 150 mg/kg bw per day flutamide for 15 days. An additional group was given single oral doses of 300 mg/kg bw iprodione per day. Luteinizing hormone, follicle-stimulating hormone, testosterone, and estradiol were determined in a blood sample taken at necropsy. No clinical signs were noted in treated animals. A decrease in body-weight gain and reduced food consumption were observed with 300 or 600 mg/kg bw iprodione or 150 mg/kg bw flutamide. Absolute and relative increases

in liver weight were found in animals receiving flutamide and in those given 600 mg/kg bw iprodione. Flutamide treatment also caused reductions in absolute testicular weight and pronounced reductions in the weights of the epididymides, all accessory sex organs, the prostate, and the seminal vesicles. Treatment with 600 mg/kg bw iprodione resulted in less pronounced weight reductions in the same organs. Peripheral plasma hormones were also affected by treatment: Flutamide increased the levels of luteinizing hormone, follicle-stimulating hormone, testosterone, and estradiol markedly, whereas iprodione caused a less pronounced increase in luteinizing hormone concentration at 600 mg/kg bw and in follicle-stimulating hormone concentration at 300 and 600 mg/kg bw per day.

In the main study, replicate groups of nine male rats were treated daily with doses of 0 or 600 mg/kg bw iprodione by gavage for 30 days. A pair-fed group was also included. A positive control group was treated daily with 150 mg/kg bw flutamide. Five rats fed iprodione died during the experiment. Weight loss was observed during the first seven days of the study, and reduced body-weight gain was seen thereafter in all treated groups, corresponding to reduced food consumption. Changes in absolute and relative organ weights, similar

to those observed in the 15-day pilot study, consisted of increased liver weights in rats treated with iprodione and flutamide and marked increases in adrenal weights, especially in those receiving iprodione. Flutamide-treated animals showed pronounced weight reductions in the epididymides, all accessory sex organs, prostate, and seminal vesicles; those treated with iprodione had similar but less pronounced reductions in these organs. The histopathological findings in animals treated with flutamide consisted of changes in the testes (degeneration of the seminiferous tubules, interstitial-cell hyperplasia), epididymides (presence of atypical luminal cells and hypospermia), seminal vesicles, and prostate (glandular atrophy); they also had liver-cell hypertrophy. In rats given iprodione, the histopathological lesions included an increased incidence of glandular atrophy of the seminal vesicles and prostate gland over that in the control group. The incidence was similar to that in the pair-fed group, but the severity of the atrophy in the seminal vesicles was more pronounced. Iprodione-treated rats had higher incidences of cytoplasmic vacuolization within the cortex of the adrenal glands and of centrilobular hepatocellular hypertrophy than those treated with flutamide. There were marked increases in the mean concentrations of luteinizing hormone, follicle-stimulating hormone, testosterone, and estradiol in flutamide-treated rats during and at the end of the study, whereas in iprodione-treated animals only the estradiol concentrations were increased. Subtle changes in the pattern of secretion of testosterone and luteinizing hormone were noted, e.g. prolongation of decreased basal concentrations of testosterone and increased pulse frequency in most concentration ranges of luteinizing hormone (Fail *et al.,* 1994).

Comments

In a study of carcinogenicity in mice, iprodione was administered over 99 weeks at dietary concentrations at 0, 160, 800, or 4000 ppm. At 800 ppm, non-neoplastic lesions were seen that included hepatocellular enlargement and hypertrophy of interstitial cells in the testis. At 4000 ppm, reduced body-weight gain, increased liver weights and increased levels of alanine and aspartate transaminases were observed. An increased incidence of liver tumours in animals of each sex and an increased incidence of luteomas of the ovaries were observed at 4000 ppm. The NOAEL was 160 ppm, equal to 23 mg/kg bw per day.

In a 104-week study of carcinogenicity in rats, the dietary concentrations were 0, 150, 300, or 1600 ppm of iprodione. At 300 ppm, increased liver weights, changes in the male reproductive system including an increased incidence of interstitial-cell hyperplasia in the testis, and hypertrophic changes in the adrenals of male rats were observed. At 1600 ppm, reduced body-weight gain and an increased incidence of interstitial-cell tumours of the testis were noted. The NOAEL was 150 ppm, equal to 6 mg/kg bw per day.

A number of studies have been conducted *in vitro* and *in vivo* to investigate the possible mechanism of tumorigenicity. Two studies *in vitro* to investigate the competitive binding capacity of iprodione to rat androgen receptors and possible inhibition of gonadotrophin-stimulated testosterone secretion in porcine Leydig cells indicated that iprodione may act by both mechanisms. The results of endocrine studies in rats *in vivo* also provide some evidence that iprodione may interfere with androgen biosynthesis.

An ADI of 0-0.06 mg/kg bw was established on the basis of an NOAEL of 6 mg/kg bw per day in the most recent two-year study of carcinogenicity in rats and a safety factor of 100.

Toxicological evaluation

Levels that cause no toxic effect

Mouse: 160 ppm, equal to 23 mg/kg bw per day (99-week study of toxicity and carcinogenicity)

Rat: 300 ppm in the diet, equal to 21 mg/kg bw per day (two-generation study of reproductive toxicity) 150 ppm equal to 6 mg/kg bw per day (104-week study of toxicity and carcinogenicity)

Rabbit: 20 mg/kg bw per day (maternal toxicity in study of developmental toxicity)

Dog: 400 ppm, equal to 18 mg/kg bw per day (one-year study of toxicity)

Estimate of acceptable daily intake for humans

0-0.06 mg/kg bw

Information that would be useful for tcontinued evaluation of the compound

Observations in humans

Toxicological criteria for setting guidance values for dietary and non-dietary exposure to iprodione

Exposure	Route, study type, species	Result, remarks
Short-term (1-7 days)	Dermal, irritation, rabbit	No irritation
	Eye, irritation, rabbit	Eye irritation
	Inhalation 4-h, lethality, rat	LC_{50} > 3.29 mg/litre
	Oral, lethality, rat	LD_{50} > 2000 mg/kg bw
	Dermal, lethality, rabbit	LD_{50} > 2000 mg/kg bw
Medium-term (1-26 weeks)	Repeated dietary, four weeks, mouse	NOAEL = 115 mg/kg bw per day; gross liver changes
	Repeated dietary, three months, two-generation study of reproductive toxicity, rat	NOAEL = 21 mg/kg bw per day; microscopic adrenal hypertrophy and reduced parental body weight
	Repeated dietary, developmental toxicity rabbit	NOAEL = 20 mg/kg bw per day for maternal toxicity; 60 mg/kg bw per day for embryotoxicity. No teratogenicity
Long-term (> one year)	Repeated dietary, carcinogenicity, rat	NOAEL = 6 mg/kg bw per day for increased liver weight; interstitial-cell hyperplasia in testis, adrenal hypertrophy; interstitial-cell tumours at highest dose

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See Also:

- Toxicological Abbreviations
- Iprodione (Pesticide residues in food: 1977 evaluations)
- Iprodione (Pesticide residues in food: 1980 evaluations)
- Iprodione (Pesticide residues in food: 1992 evaluations Part II Toxicology)

United States Environmental Protection Agency | Prevention, Pesticides And Toxic Substances (7508C) | EPA-738-F-98-017 NOVEMBER 1998

EPA R.E.D. FACTS

IPRODIONE

Pesticide Reregistration

All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment. Because of advances in scientific knowledge, the law requires that pesticides which were first registered before November 1, 1984, be reregistered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that can be used without posing unreasonable risks to human health or the environment.

When a pesticide is eligible for reregistration, EPA explains the basis for its decision in a Reregistration Eligibility Decision (RED) document. This fact sheet summarizes the information in the RED document for reregistration case 2335, iprodione [3-(3,5-dichlorophenyl)-N-(1-methylethyl)-2,4-dioxo-1-imidazolidinecarboxamide].

Use Profile

Iprodione is a contact and/or locally systemic fungicide registered for use on a variety of field, fruit, and vegetable crops, including almonds, grapes, peaches, potatoes, rice, berries, onions, peanuts, lettuce, golf courses, lawns, and ornamentals. There are currently 70 tolerances for iprodione. These end-use patterns for the current formulations have been classified for outdoor use only, applications include aircraft (fixed-wing and helicopter), airblast sprayer, chemigation, groundboom, high- and low-pressure handwand, backpack sprayer, and tractor-drawn spreader. Iprodione is formulated as a liquid, dry flowable, wettable powder, and granular.

Regulatory History

Iprodione was first registered in the U.S. in 1979 as a fungicide. Rhone-Poulenc Ag Co., is the current manufacturer of iprodione. A data call-in was issued in September 1991. Currently, 21 iprodione products are registered,

along with 18 Special Local Needs registrations (SLNs). Product concentrations range from 1.5% active ingredient to 95% active ingredient.

Human Health Assessment

Toxicity

In studies using laboratory animals, iprodione generally has been shown to be of low acute toxicity. It is slightly toxic by the eye, dermal and oral routes and has been placed in Toxicity Category III (the second lowest of four categories) for these effects. In acute inhalation and as a dermal sensitizer, iprodione is practically non-toxic (Category IV).

Iprodione was not mutagenic in several studies. Iprodione has been classified as a Group B2, or "likely," human carcinogen, based on evidence of tumors in both sexes of mouse (liver) and in the male rat (Leydig cell). A Q* of 4.39 x 10^{-2} was used for estimating carcinogenic risk (Leydig cell).

The endpoints selected for both the acute (decreased anogenital distance (AGD)) and the chronic (histopathology of male reproductive system) risk assessments are based on developmental and reproductive effects. It was determined that the additional 10x Safety Factor for the protection of infants and children (as required) by FQPA should be reduced to 3x and the rationale for reducing the 10x factor to 3x are as follows: no enhanced susceptibility was seen in rat and rabbit developmental and the two generation reproduction study in rats; the critical endpoint for acute dietary risk assessment (decreased AGD) was seen at a high dose (120 mg/kg/day) and there were only marginal differences in the degree of decreased AGD between the doses 20 mg/kg/day, 120 mg/kg/day, and 250 mg/kg/day thus indicating the "true" NOEL could be higher than the one established at 20 mg/kg/day; the proposed mode of action of iprodione is disruption of testosterone biosynthesis; the use of a realistic dietary exposure data (refined using monitoring data and percent crop treated).

The Agency used the developmental NOEL of 20 mg/kg/day based on AGD in male fetuses to assess acute dietary risk. The acute reference dose (RfD) for iprodione is 0.06 mg/kg/day. The Agency used the toxicity/carcinogenicity NOEL of 6.1 mg/kg/day to assess the chronic dietary risk for iprodione based on histopathological lesions in the male reproductive system and effects of the adrenal glands. The chronic RfD for iprodione is 0.02/kg/day.

Iprodione is structurally related to vinclozolin and procymidone. Each of these three pesticides can metabolize to 3,5-dichloroaniline (3,5-DCA). FQPA requires EPA to estimate cumulative risk from consumption of food and water containing 3,5-DCA derived from iprodione, vinclozolin, and procymidone. A

Q* of 6.38 X 10^{-2} (mg/kg/day) in human equivalents has been calculated for p-chloroaniline. This Q* is based on the spleen sarcoma rate in male rats from a bioassay study, linearized low-dose multistage model, and the 3/4s interspecies scaling factor.

Dietary Exposure

People may be exposed to residues of iprodione through the diet and drinking water. Tolerances were reassessed for iprodione and have been established in 40 CFR 180.399 for the following commodities: almonds, hulls; almonds, nutmeat; apricots; beans, dried, vine hay; beans, dry; beans, forage; beans, succulent; blueberries; boysenberries; broccoli; caneberries; carrots; cherries (sour); cherries (sweet); Chinese mustard; currants; garlic; ginseng; grapes; kiwi fruit; lettuce; nectarines; onions, dry bulb; peaches; peanuts; peanut forage; peanut hay; plums; potatoes; prunes; raspberries; rice grain; rice straw; strawberries; cattle, fat, kidney, liver, meat, meat byproducts; eggs; goats, fat, kidney, liver, meat, meat byproduct; hogs, fat, kidney, liver, meat, meat byproduct, horses, fat, kidney, liver, meat, meat byproduct; milk; poultry, fat, liver, meat, meat byproduct; and, sheep, fat, kidney, liver, meat, meat byproduct.

Occupational and Residential Exposure

Handlers (mixers, loaders, and applicators) of iprodione may be exposed to iprodione during and after normal use of liquid, wettable powder, dry flowable, and granular formulations. For dermal exposure, no short- and intermediate-term dermal risk for iprodione. For inhalation exposure, the current use of iprodione does not indicate a concern for long-term exposure or risk. Based on the use patterns and potential exposures, nineteen exposure scenarios for handlers were identified and assessed for iprodione. Rhone-Poulenc has voluntarily canceled all residential uses of iprodione.

Human Risk Assessment

The Agency was concerned about the cancer risk and the acute dietary risk posed by exposure to iprodione. The target Margin of Exposure (MOE) for acute dietary risk is 300; MOEs above 300 are not considered to be of concern. Acute MOEs for iprodione are calculated for females 13+ only, as discussed previously. With risk mitigation measures in place, the MOE for the

acute risk from food and drinking water for iprodione is 351, which the Agency considers acceptable.

Aggregate cancer risk from iprodione (from dietary, residential and water exposure) with risk mitigation measures in place is 1.8×10^{-6}, which is within the range that the Agency currently considers acceptable.

With personal protective equipment (PPE) in place, risk to handlers of iprodione are considered acceptable. The Agency has also determined that a restricted-entry interval (REI) of 24-hours reduces the post-application risks posed by iprodione to workers.

The cumulative carcinogenic risk estimate for consumption of food and wine containing residues of 3,5-DCA as a result of use of iprodione, vinclozolin, and procymidone is $9.5 \text{ X } 10^{-7}$.

Environmental Assessment

Environmental Fate

The major routes of dissipation are hydrolysis in neutral and alkaline environments (half-life pH 7 = 4.7 days; pH 9 = 27 minutes) and microbial degradation under both aerobic and anaerobic conditions. The overall result of these mechanisms of dissipation appears to indicate that iprodione has low to intermediate persistence in the environment. The results obtained in the field confirm the expected low persistence of iprodione ($t_{1/2}$ = 3-7 days).

Despite the fact that iprodione is mobile to highly mobile in some soils, it is unlikely that it will leach to ground water because of its rapid degradation in the environment. In addition, because iprodione is typically applied as a foliar treatment, degradation/metabolism on the plant surface and/or absorption by plants will further mitigate the potential for ground water contamination.

Ecological Effects

For acute exposure, iprodione is practically nontoxic to slightly toxic to birds, practically nontoxic to small mammals, relatively nontoxic to bees, moderately toxic to freshwater fish, moderately toxic to estuarine and marine fish, and moderately to highly toxic to estuarine and marine invertebrates. Chronic toxicity studies established the following No Observable Effect Concentration (NOEC) values and ecological endpoints affected: 300 ppm for birds (decreased hatchling body weight), 500 ppm for small mammals (decreased fetal weight); > 0.26 ppm for freshwater fish (larval survival);

> 0.17 ppm for freshwater invertebrates (offspring/female, mean percentage survival, growth); > 3.5 ppb for estuarine and marine invertebrates (offspring/female/reproductive day).

Ecological Effects Risk Assessment

EPA is generally concerned about the ecological effects to terrestrial wildlife and aquatic organisms posed by exposure to iprodione. The risk assessment for iprodione shows various levels of concern regarding avian risk and mammalian risk from broadcast applications of granular and nongranular products used on turf and ornamentals. In addition, most agricultural uses present acute and chronic risks of varying levels to endangered and nonendangered aquatic organisms, with turf and rice demonstrating the higher risks. In general, the risks to invertebrates are greater than the risks to fish. The turf and rice uses present high acute risks for nonvascular aquatic plants. With risk mitigation measures in place, the Agency considers these risks acceptable.

Risk Mitigation

To lessen human health risk, residential risk, worker risk, and ecological effects posed by iprodione, Rhone-Poulenc has requested changes to its iprodione registrations, including the following mitigation measures.

- For iprodione use on strawberries, increase the pre-harvest interval from 0-days to up to but not after first flower. In addition, the tolerance for strawberries will be reduced to the limit of quantitation (0.05 ppm).
- For iprodione use on all stone fruit (apricots, cherries, nectarines, plums, and prunes), increase the pre-harvest interval from 7-days to up to but not after petal fall (approximately 45 - 90-day pre-harvest interval). In addition, the tolerances for all stone fruit, including peaches, will be reduced to limit of quantitation (0.05 ppm).
- For iprodione use on table grapes (fresh, cooked, canned, juice, raisin or otherwise; mitigation does *not* include wine and sherry grapes), reduce the application rate from 4 times per season to one application per season at early- to mid-bloom. Tolerances remain unchanged consistent with the RED (10 ppm).
- Cancellation by Rhone-Poulenc of all residential uses of iprodione.
- Limit the maximum number of applications on non-residential turf, lawn, golf course, ornamental trees, and ornamental plants from “unlimited” to 6

per year, with the maximum annual application of up to but no more than 24 lbs. a.i..

- Except for use of iprodione on golf courses, include label warnings requiring a vegetative buffer strip of at least 25-feet for application of iprodione adjacent to water bodies such as lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish ponds.
- For use on golf courses, the following statement will be included on the label: “for golf courses only, do not apply to turf cut higher than 1" on golf holes where water bodies are present.”
- Include label warnings to prevent application of iprodione when wind direction is toward aquatic area.
- Cancellation by Rhone-Poulenc of all herbaceous ornamental seed treatment uses.
- All wettable powder formulations must be packaged in water-soluable bags.
- For rice use only, continue to include endangered species restrictions in the state of Arkansas (for the fat pocketbook pearly mussel and its habitat).

Additionally, there are a number of risk mitigation measures required in the RED to protect mixers, loaders, applicators and workers. For a detailed list, refer to Chapter IV of the Iprodione RED document. With the above mitigation measures, and the agreed upon changes to labels by Rhone-Poulenc, all uses of iprodione are eligible for reregistration.

Additional Data Required

The generic data base supporting the reregistration of iprodione for the above eligible uses has been reviewed and determined to be substantially complete. For confirmatory purposes, the following information is being required:

- Pre and/or Post-Natal Exposure Study *[GLN 83-3(a)]*;
- UV/Visible Absorption *[OPPTS 870.7050];*
- Density *[GLN 63-7]*;
- Product Chemistry Reports *[GLN 61/62]*;
- Aquatic Plant Growth Study *[GLN 122-2]*;
- Aerobic Soil Metabolism *[GLN 162-1]*;
- Leach/Adsorp/Desorption *[163-1]*;
- Confined Rotational Crop Study *[165-1]*;

- Estimation of Dermal/Inhalation Exposure *[GLN 231/232]*;
- Residue Analytical Methods *[GLN 171-4(d)]*;
- Crop Field Trial Studies (strawberries, stone fruit) *[GLN 171-4(k)]*;
- Surface Water Monitoring Study *[Special Study]*;

Product Labeling Changes Required

All iprodione end-use products must comply with EPA's current pesticide product labeling requirements and with those labeling requirements imposed in the Iprodione RED. For a comprehensive list of labeling requirements, please see section V of the Iprodione RED document.

Regulatory Conclusion

The Agency has determined that existing uses of iprodione are eligible for reregistration subject to conditions imposed in the RED. These include removal of all residential uses of iprodione (residential turf, residential ornamentals and residential vegetable/small fruit gardens) from product registrations due to cancer risk concerns. Also, to protect handlers of granular iprodione products, removal of belly grinder application method from iprodione product registrations. Lastly, to mitigate risks to birds, removal of herbaceous ornamental seed treatment from all iprodione registrations. Rhone-Poulenc has already requested these changes to its iprodione registrations. All other uses of iprodione are eligible for reregistration.

For More Information

EPA is requesting public comments on the Reregistration Eligibility Decision (RED) document for iprodione during a 60-day time period, as announced in a Notice of Availability published in the Federal Register. To obtain a copy of the RED document or to submit written comments, please contact the Pesticide Docket, Public Response and Program Resources Branch, Field Operations Division (7506C), Office of Pesticide Programs (OPP), US EPA, Washington, DC 20460, telephone 703-305-5805.

Electronic copies of the RED and this fact sheet are available on the Internet. See http://www.epa.gov/REDs.

Printed copies of the RED and fact sheet can be obtained from EPA's National Center for Environmental Publications and Information (EPA/NCEPI), PO Box 42419, Cincinnati, OH 45242-0419, telephone 513-489-8190, fax 513-489-8695.

Following the comment period, the Iprodione RED document also will be available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, telephone 703-487-4650.

For more information about EPA's pesticide reregistration program, the Iprodione RED, or reregistration of individual products containing iprodione, please contact the Special Review and Reregistration Division (7508C), OPP, US EPA, Washington, DC 20460, telephone 703-308-8000. For information about the health effects of pesticides, or for assistance in recognizing and managing pesticide poisoning symptoms, please contact the National Pesticides Telecommunications Network (NPTN). Call toll-free 1-800-858-7378, between 9:30 am and 7:30 pm Eastern Standard Time, Monday through Friday.