PAN International List of Highly Hazardous Pesticides

(PAN List of HHPs)

December 2016

Pesticide Action Network International

Impressum

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This 'PAN International List of Highly Hazardous Pesticides' was initially drafted by PAN Germany for PAN International. The 1st version was adopted by PAN International 2008 and published January 2009. Since then the list has been updated several times as classifications changed for numerous individual pesticides. In 2013/2014 the PAN International Working Group on “HHP criteria” revised the criteria used in this list to identify highly hazardous pesticides.
This December 2016 version of the list is based on these hazard criteria adopted by PAN International in June 2014.

Contents

Background and introduction

For decades, the distribution and use of hazardous pesticides has been an issue of concern. Since its founding in 1982, Pesticide Action Network (PAN) has been the civil society organization most steadily and continuously calling for effective international action on the elimination of hazardous pesticides. PAN has been one of the key driving forces among non-governmental organisations (NGOs) for improving pesticide and crop protection policies towards safer, socially just, environmentally sustainable and economically viable pest management systems.

1980s: the first international Code of Conduct on pesticides

In 1985 the *International Code of Conduct on the Distribution and Use of Pesticides* was adopted by the United Nations Food and Agriculture Organization (FAO) to respond to the growing evidence of risks and harm associated with the use of pesticides. The first version of the 'Code of Conduct' already indirectly questioned the effectiveness of the 'safe use of pesticides' concept as an overall approach to solving pesticide related problems – the Code Article 5.2.3 stated that "*industry should halt sale and recall products when handling or use pose an unacceptable risk under any use directions or restrictions*". Since the 1980s a number of international instruments and guidelines have been adopted[1] to tackle pesticide related problems. Additionally, many public and private initiatives have been implemented to reduce the adverse effects of pesticide use in agriculture. However, in general, these initiatives have been successful only to a limited extent and the 'safe use' training approach to highly hazardous pesticides has been questioned increasingly by NGOs, scientists, governmental representatives, UN agencies and the private sector.

2000s: a new paradigm emerges on reducing hazards, as well as risks

Meanwhile numerous initiatives in food, forestry and flower production and distribution chains have developed their own prohibited or restricted lists for specific pesticides. In November 2009, the European Union abandoned its former paradigm based on assessment of pesticide *risks* only, with its new pesticide authorisation Regulation 1107/2009/EC,[2] which emphasises the need to take intrinsic hazards into account. Accordingly, Reg. 1107/2009 stipulates that pesticide substances (active ingredients) proven to be carcinogenic, mutagenic, toxic for reproduction and endocrine disruptors shall *not* be authorised in the EU.

In 2006, the Strategic Approach to International Chemicals Management (SAICM) was adopted. This voluntary agreement, under the auspices of the United Nation Environmental Programme (UNEP), recognised the need for action to reduce dependency on pesticides worldwide, including phasing out highly toxic pesticides and promoting safer alternatives. In November 2006, the FAO Council discussed and endorsed SAICM. 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***

[1] E.g. the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int), the Stockholm Convention on Persistent Organic Pollutants (http://www.pops.int) and the Strategic Approach to International Chemicals Management (http://www.saicm.org/)

[2] EC (2009): Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC. Official Journal of the European Union L 309. 24.11.2009

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 term 'progressive ban' refers to national or regional regulatory banning over time of different pesticides identified as highly hazardous, and/or voluntary step-by-step phase out of their use by individual food and fibre companies, private standards or others.

In April 2007, the FAO Council informed the Committee on Agriculture (COAG)[3] of its intention to develop a new initiative for pesticide risk reduction. COAG welcomed the initiative to reduce risks associated with the use of hazardous pesticides, including the progressive ban on highly hazardous pesticides.[4]

2007: FAO and WHO launch the Highly Hazardous Pesticide initiative

In October 2007, the FAO/WHO Joint Meeting on Pesticide Management (JMPM) discussed the so-called thought starter paper "*Addressing Highly Toxic Pesticides (HTPs)*" with a note from the Secretariat explaining: "*Through this thought-starter FAO wishes to start its work on highly hazardous pesticides.*" (...) "*This thought-starter builds on the information document provided to COAG on pesticide risk reduction. As a first step, this paper focuses on options for defining highly hazardous pesticides.*" Based on this thought starter the JMPM outlined criteria to identify highly hazardous pesticides (HHPs). In addition, the JMPM "*recommended that FAO and WHO, as a first step, should prepare a list of HHPs based on the criteria identified, and update it periodically in cooperation with UNEP. It further requested that such a list should be made widely known to all stakeholders involved in pesticide regulation and management*."[5]

Also in 2007 the JMPM developed the following criteria for highly hazardous pesticides:

- 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

[3] The FAO Committee on Agriculture (COAG) conducts periodic reviews and appraisals of agricultural and nutritional problems in order to propose concerted action by Member Nations and the Organization. It also reviews the agriculture and food and nutrition work programmes of the Organization and their implementation, with emphasis on the integration of all social, technical, economic, institutional and structural aspects in promoting agricultural and rural development. Its functions are enumerated in Rule XXXII of the General Rules of the Organization. Membership must be renewed formally each biennium

[4] The Report of the Twentieth Session of the Committee on Agriculture (Rome, 25-28 April 2007), CL 132/9, is available at: http://www.fao.org/unfao/bodies/coag/coag20/index_en.htm

[5] The minutes of the panel of experts meeting October 2007 are available at: http://www.fao.org/agriculture/crops/core-themes/theme/pests/code/panelcode/en/

- 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.[6]

2009: PAN International publishes its first PAN List of HHPs

PAN International strongly welcomed the decisions made by the FAO Council, the COAG and the JMPM. PAN was of the opinion, however, that the list of HHP criteria agreed by the JMPM had some important shortcomings: in particular, it is important to note that pesticides with endocrine disrupting properties, eco-toxicological properties, or inhalation toxicity have *not* been taken into account by the JMPM.

Because of these shortcomings, PAN International decided to independently build on the JMPM criteria for HHPs to develop a more comprehensive set of hazard criteria, used by recognised authorities, such as the EU and the US Environmental Protection Agency (EPA), and to develop a list of HHP pesticide active ingredients based on these selected criteria.

Meanwhile, international pressure to curb the use of HHPs has continued to increase. In September 2012, at the third International Conference on Chemicals Management in Nairobi, over 60 countries and other participating organizations called for the Conference to support the development of a list of HHPs, a progressive ban of HHPs, and their substitution with safer alternatives. No decision was taken as the item was not on the formal agenda; however, intercessional regional SAICM meetings discussed proposals for action on highly hazardous pesticides leading up to the Open-Ended Working Group in late 2014 and the fourth International Conference on Chemicals Management in 2015.[7]

2013-2016: Stakeholder action grows on addressing HHPs

In 2013, the updated and renamed *International Code of Conduct on Pesticide Management* was released. It was originally intended to contain an annex with the JMPM criteria for HHPs. However, it was decided instead to develop a separate guidance document: 'Guidelines on Highly Hazardous Pesticides'. The purpose of the guidance document is to provide a framework and practical methods for identifying HHPs, along with methods for their control. The definition of HHPs in the new Code of Conduct on Pesticide Management (adopted by FAO and WHO in 2013) and in the Guidelines on Highly Hazardous Pesticides, adopted in 2016[8]) is:

> "*Highly Hazardous Pesticides means pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems such as WHO or GHS or their listing in relevant binding international agreements or conventions. In addition, pesticides that*

[6] The minutes of the panel of experts meeting October 2007 are available at: http://www.fao.org/agriculture/crops/core-themes/theme/pests/code/panelcode/en/

[7] PAN and IPEN (2013): Thought starter paper on Highly Hazardous Pesticides and the Strategic Approach to International Chemicals Management submitted by PAN and IPEN. SAICM/RM/LAC.4/INF/9. 4th Latin American and Caribbean regional meeting on the Strategic Approach to International Chemicals Management (SAICM) and related consultations, Mexico City, 19 to 22 August 2013

[8] FAO and WHO (2016): International Code of Conduct on Pesticide Management. Guidelines on Highly Hazardous Pesticides, Rome 2016 http://www.fao.org/publications/card/en/c/a5347a39-c961-41bf-86a4-975cdf2fd063/

appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous."

The Code also contains a definition of the term 'hazard':

"Hazard means the inherent property of a substance, agent or situation having the potential to cause undesirable consequences (e.g. properties that can cause adverse effects or damage to health, the environment or property)."

The Present

To implement a progressive ban of HHPs as supported by the FAO Council, the COAG, the JMPM and others, all stakeholders mentioned in the International Code of Conduct on the Distribution and Use of Pesticides should develop plans of action for a progressive ban of HHPs. These stakeholders include governments, the pesticide industry, the food industry, farmers and farmer organizations and public interest groups.

This active stakeholder participation is especially important as there are currently no legal instruments available to achieve a structured and clearly targeted global progressive ban of HHPs other than the Stockholm Convention for Persistent Organic Pollutants (POPs), which focuses only on a very small group of HHPs.

The PAN International List of HHPs provides a basis for action to implement the progressive ban of highly hazardous pesticides and replace them with safer, agro-ecological and other appropriate non-chemical alternatives. PAN would like to encourage individuals, institutions, organizations and companies to develop a plan of action with priorities, timeframes and concrete measures. PAN itself will support such initiatives wherever possible.

We thank Carina Weber, former executive director of PAN Germany, for her long-standing work on the PAN International List of HHPs.

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PAN Africa
PAN Asia and the Pacific
PAN Europe (PAN Germany and PAN UK)
PAN Latin America
PAN North America

About this List

History

The *PAN International List of Highly Hazardous Pesticides* was initially developed by PAN Germany for PAN International to answer the question "What are highly hazardous pesticides?" The first version of this HHP List was published January 16th, 2009. In 2013/2014 PAN International reviewed the hazard criteria used in this list and changes were agreed in 2014. These relevant changes had been explained in the section *'What is new in this list?'* in the 2015 PAN International HHP List. No changes of criteria had been carried out since. This December 2016 version of the list is based on these hazard criteria adopted by PAN International in June 2014.

Purpose

This publication describes how PAN International defines Highly Hazardous Pesticides (HHPs) by identifying the hazard criterion indicators. An explanation of the different hazard criteria selected is followed by a list of HHPs generated on the basis of these criteria. The PAN International HHP List serves as a list of pesticides to be progressively banned. All stakeholder groups can use it as a decision tool for their pesticide policies, such as developing prohibited or restricted lists in private standards or to prioritise actions for reducing pesticide hazards and risks in a specific country.

Focus and scope

The PAN HHP list contains active ingredients intended to destroy, deter, render harmless, prevent the action of, or otherwise exert a controlling effect on any harmful or annoying organism, or manage vegetative growth, except for those used as disinfectants, or internal human or veterinary medicines. It includes: pesticides used in agriculture, forestry, fisheries, vector control, homes, other buildings, and transport; those used for control of ectoparasites (e.g. ticks on livestock); rodenticides and other vertebrate poisons; wood preservatives; plant growth regulators; fumigants; and those incorporated into materials and other products. It excludes: synergists, safeners, adjuvants and other additives in formulated pesticide products; and all the break-down products (metabolites) of pesticide active ingredients.

Basis

The PAN HHP list is currently based only on classifications by recognised authorities. In future, it will also be based on recorded cases of pesticide active ingredients and formulations that have shown a ***high incidence of severe or irreversible adverse effects*** on human health or the environment, when robust, evidence-based and publicly accessible data becomes available.

Structure

The hazard criteria are grouped into:

- acute toxicity
- long term (chronic) health effects
- environmental hazard criteria
- international regulations (global pesticide-related conventions)

Limitations

It is important to note that the list of HHPs presented in this publication is *still not complete*. There are several reasons for these limitations:

- One major reason is that the criteria used for the PAN definition of HHPs are based on widely accepted classifications. Due to the time needed for achieving consensus on 'individual pesticides' class or category these classifications do have shortcomings, as explained in this publication.
- Another reason is that science research shows a number of so-called "emerging properties" about new or poorly understood side effects, e.g. pesticides with endocrine disrupting properties. Such properties and appropriate definitions, hazard classifications and threshold values are not sufficiently operationalised for pesticides as yet.
- Measures to identify substances of high environmental concern are currently restricted to selected criteria which do not reflect the overall environmental concerns.
- In addition, pesticides that may be shown to be linked with a high incidence of severe or irreversible adverse effects on human health or the environment are not identified systematically yet. Based on ongoing community monitoring of pesticide impacts and scientific literature research, PAN will identify and list such highly hazardous pesticides in the future.
- Experiences in the past show that pesticides classified as only "moderately hazardous" by the World Health Organization (WHO Class II) nevertheless give valid reason for concern. Examples are endosulfan and paraquat, pesticides that have caused thousands of poisonings, especially in developing countries, or pyrethroids which are known to cause various ill health incidences in the US. However, with a view to prioritisation, PAN decided not to add WHO II ("moderately hazardous") pesticides to the list of hazard criteria for acute toxicity.
- Contamination with dioxin: in the context of the Stockholm Convention, the Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs (January 2013), identified a number of pesticides that can be contaminated with the highly toxic by-product dioxin during the production process and remain in the final product; these pesticides include 2,4-D, chlornitrofen or 2,4,6-trichlorophenyl-4-nitrophenylether (CNP), pentachlorophenol (PCP), and sodium pentachlorophenol (PCP-Na). This is a hazard feature the list is not considering currently.
- Pesticides classified as obsolete pesticides by FAO and WHO are not included in the list. Accordingly, the 2013 update of the PAN HHP List removed several pesticides now classified as obsolete by FAO. However, it could be that limited uses still happen illegally, especially if obsolete stockpiles remain.

What is new in this List

This December 2016 version serves as annual update triggered by new evaluations. No changes regarding the set of criteria for identifying HHPs have been made since the last update in 2015.

One pesticide has been deleted:
Imazethapyr had been removed from the list. New data shows that it is not classified as 'highly toxic for bees'. Its bee toxicity (LD50, µg/bee) is >24.6 (oral; 48 h), >100 (contact; 48 h).

Two pesticides have been added:
Pendimethalin – for being persistent and bioaccumulative and

Triflumizole – as probable reproductive toxin (GHS Repr. 1B).

Since several salts of the boric acid are now classified as probable reproductive toxin (GHS Repr. 1B) they are now grouped together as one entry 'Borax, Borate salts'.

Work in progress

The FAO definition of a HHP includes **pesticides *linked with a high incidence of severe or irreversible adverse effects on human health or the environment***. However, such pesticides are not yet systematically identified via a single, globally recognised assessment or classification process (as mentioned above under limitations).

PAN International is working on indicators, threshold values and reliable and consistent data sources to identify pesticides causing irreversible adverse effects on ***humans***. PAN International already agrees on suitable criteria for intentional and occupational or accidental poisoning: the Poisoning Severity Score (PSS) and/or the case fatality rate (CFR).[9]

However, setting the threshold value for what level or scale of poisoning incidence should qualify as an HHP is a subjective question, based on personal judgement of the ethical aspects, for which PAN has not yet developed an agreed position. In addition, poisoning data based upon active ingredients are not widely available. It was therefore decided to start by collecting available, robust and well-documented data and then to discuss appropriate threshold values to be considered.

Another area of work is to look at environmental hazard criteria for other ecosystem services, beyond pollination. Especially relevant for pesticide policy is the service of natural pest control provided by a range of beneficial organisms (natural enemies of insect pests, crop diseases and weeds). These beneficial organisms are of such major agro-ecological (and economic) importance that pesticides severely interfering with their 'services' should not be used. However, a robust or comprehensive classification which could be used for this natural pest control criterion is not yet available.

PAN International plans to work on this issue very soon and invites scientists who are interested in supporting the development of such a criterion to contribute their suggestions and expert advice.

[9] www.who.int/ipcs/poisons/pss.pdf

Feedback welcome!

PAN International warmly welcomes constructive feedback from any stakeholders involved in pesticide risk management or policy on this updated and revised version of the PAN HHP List. In particular, we are keen to learn how the List is being used in decision-making in public or private sector organisations, along with any suggestions of how it could be improved in the next version or disseminated more widely.

Please send your feedback to:

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PAN International Indicators for Identifying 'Highly Hazardous Pesticides'

The following Table shows the criteria and sources used by PAN to identify pesticides considered to be highly hazardous according to PAN.

High acute toxicity
'Extremely hazardous' (Class Ia) according to WHO Recommended Classification of Pesticides by Hazard or
'Highly hazardous' (Class Ib) according to WHO Recommended Classification of Pesticides by Hazard or
'Fatal if inhaled' (H330) according to the Globally Harmonized System (GHS) or
Long term toxic effects
Carcinogenic to humans according to IARC, US EPA or 'Known or presumed human carcinogens' (Category I) according to the Globally Harmonized System (GHS) or
Probable/likely carcinogenic to humans according to IARC, US EPA or
'Substances known to induce heritable mutations or to be regarded as if they induce heritable mutations in the germ cells of humans', 'Substances known to induce heritable mutations in the germ cells of humans' (Category I) according to the Globally Harmonized System (GHS) or
'Known or Presumed human reproductive toxicant' (Category I) according to the Globally Harmonized System (GHS) or
Endocrine disruptor
'Suspected human reproductive toxicant' (Category 2) *AND* 'Suspected human carcinogen' (Category 2) according to the Globally Harmonized System (GHS) or
potential endocrine disruptor according to EU Category 1 or
High environmental concern
Pesticides listed in Annex A & B of the Stockholm Convention or Ozone depleting according to the Montreal Protocol or
High environmental concern – where <u>two</u> of the three following criteria are met:
P = 'Very persistent' half-life > 60 days in marine- or freshwater or half-life > 180 days in soil ('typical' half-life), marine or freshwater sediment) (Indicators and thresholds according to the Stockholm Convention) and/or
B = 'Very bioaccumulative' (BCF >5000) or Kow logP > 5 (existing BCF data supersede Kow log P data) (Indicators and thresholds according to the Stockholm Convention) and/or
T = Very toxic to aquatic organisms (LC/EC 50 [48h] for Daphnia spp. < 0,1 mg/l)
Hazard to ecosystem services
'Highly toxic for bees' according to U.S. EPA (LD50, µg/bee < 2) or
Known to cause a high incidence of severe or irreversible adverse effects
Pesticides listed in Annex III of the Rotterdam Convention

Explanatory notes and comments regarding the classification systems, lists and indicators being used by PAN to identify Highly Hazardous Pesticides

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

The aim of the GHS is a global harmonization of the classification and labelling of chemicals. The Plan of Implementation of the World Summit on Sustainable Development (WSSD), adopted in Johannesburg in 2002, encourages countries to implement the GHS. However, it has not yet been fully implemented on a global scale. The European Union converted its classification and labelling system (Directives 67/548/EC and 1999/45/EC) to the GHS system (Regulation 1272/2008/EC) in 2015.

Source used:

Since the GHS classification has not been established on a global scale PAN International applies the EU GHS (Regulation 1272/2008/EC and its amendments) for the development of the PAN List of HHPs

The WHO Recommended Classification of Pesticides by Hazard

The latest revision of the WHO Recommended Classification of Pesticides by Hazards was conducted in 2009 and contains about 870 pesticides. PAN included those pesticides listed in WHO Class Ia and Ib in the PAN HHP list.

The most recent version of the WHO classification must be considered incomplete for the following reasons:

- The WHO classification for the oral acute toxicity to rats presents in some cases a gross underestimation of the real risk for humans (see Dawson et al. 2010[10]). Pesticides with the highest documented human fatality rates: paraquat dichloride and endosulfan (ibid.) are neither rated 'Extremely hazardous' nor 'Highly hazardous' (i.e. not in Class Ia or Ib).
- Since the last revision a large number of new active ingredients have entered the market, but their hazards have not yet been classified by WHO. Some of these new pesticides may qualify as HHPs.
- LD_{50} values for inhalation toxicity are not included in the WHO classification. This is a major deficiency because users of pesticides are often exposed via inhalation.
- Endocrine disruption is not included in the WHO classification.
- Formulations are not included in the classification. The acute toxicity of formulations and mixtures can be calculated based on the percentage and the LD_{50} values of the active ingredients in the formulation or mixture. However, so-called 'inert' ingredients or solvents[11] are neglected in this calculation although they may have an influence on the toxicity of the formulation or the mixture.

[10] Dawson AH, Eddleston M, Senarathna L, Mohamed F, Gawarammana I, Bowe SJ, Manuweera G, Buckley NA (2010): Acute Human Lethal Toxicity of Agricultural Pesticides: A Prospective Cohort Study. PLoS Medicine 7(10): e1000357

[11] "Inert" ingredients are substances which can enhance the efficiency of the active substance, make a product more degradable or easier to use. 'Inerts' are mostly handled as trade secrets of the manufacturer, which means they are not included on the product label.

Source used:

WHO (2010): The WHO recommended classification of pesticides by hazard and guidelines to classification 2009, International Program on Chemical Safety (IPCS) & World Health Organization (WHO), Geneva

Regulation 1272/2008/EC – EU GHS

The EU Regulation1272/2008/EC on classification, labelling and packaging of substances and mixtures entered into force in January 2009. It implements the Globally Harmonized System (GHS).

Classification and labelling of chemicals according to EU Regulation1272/2008/EC follows very similar criteria to those in the older Council Directive 67/548/EC, but uses new pictograms instead of the old danger symbols and instead of the earlier 'Risk' and 'Safety' phrases it uses 'Hazard Statements' and 'Precautionary Statements', respectively.

PAN uses EU Regulation1272/2008/EC and its amendments to identify pesticides which are considered highly toxic via inhalation, carcinogenic, mutagenic and/or toxic to reproduction.

Sources used:

Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006. Official Journal of the European Union L 353/1 and its amendments

International Agency for Research on Cancer (IARC)

The International Agency for Research on Cancer (IARC) is part of the World Health Organization (WHO). The goal of IARC is to evaluate, with the assistance of international working groups of experts, critical reviews and evaluations of evidence of carcinogenicity and to publish them in monographs. This series of monographs started in 1972 and since then, almost 900 agents have been reviewed. Participants in the working groups are individual scientists who do not represent organizations, industry or governments.

Only those pesticides which are classified as 'carcinogenic to humans' or 'probably carcinogenic to humans' have been included in this revised version of the PAN List of HHPs.

Source used:

IARC (2015): Agents reviews by the IARC Monographs, Volumes 1-112 (by CAS Numbers), International Agency for Research on Cancer (IARC), Lion, France. Website: http://monographs.iarc.fr/ENG/Classification/

U.S. Environmental Protection Agency (U.S. EPA)

The U.S. EPA Office of Pesticide Programs maintains a List of Chemicals Evaluated for Carcinogenic Potential[12]. This list is a product of the general risk assessment included in the process of pesticide registration. This classification includes the potential exposure of humans[13]. Therefore, a low exposure potential can place a pesticide in a lower category even when sufficient evidence of carcinogenicity exists. U.S. EPA's classification of carcinogenicity has changed several times over the last 20 years. The list is updated annually, but its focus is mostly on pesticides registered in the USA.

Source used:

US EPA (2015): Annual Cancer Report 2015. Chemicals Evaluated for Carcinogenic Potential, Science Information Management Branch, Health Effects Division, Office of Pesticide Programs U.S. Environmental Protection Agency (US EPA), Washington DC, USA

Classification for bee toxicity

The US EPA also defines categories for environmental toxicity of pesticides[14]. US EPA defines a pesticide as highly toxic to bees if the LD_{50} is lower than 2 micrograms per bee (µg/bee). Pesticides highly toxic to bees are included in the PAN List of HHP.

EU categorisation of endocrine disruptors

The issue of endocrine disrupting pesticides gained widespread public, political and scientific attention at the beginning of the 1990s. Today there are still no confirmed lists of pesticides with endocrine disrupting properties on any official national or international level (e.g. EU, WHO). However, the EU has developed a priority list of pesticides with evidence for endocrine disrupting properties. In the PAN list of HHPs all EU Category 1 pesticides (at least one study providing evidence of endocrine disruption in an intact organism) are included.

With Regulation 1107/2009/EC the European Union decided to exclude from EU authorization those pesticide active ingredients, which have endocrine disrupting properties that may cause adverse effects in humans or in non-target organisms. By 14 December 2013, the European Commission was scheduled to present a draft of the measures concerning specific scientific criteria for the determination of endocrine disrupting properties. Pending the adoption of these criteria, substances that are or have to be classified in accordance with the provisions of Regulation (EC) No 1272/2008 as carcinogenic category 2 and toxic for reproduction category 2 shall be considered to have endocrine disrupting properties (EC 2009).

[12] US EPA (2012): Chemicals Evaluated for Carcinogenic Potential, November 2012, Science Information Management Branch, Health Effects Division, Office of Pesticide Programs U.S. Environmental Protection Agency (US EPA), Washington DC, USA

[13] Altenburger, R., Bödeker, W., Brückmann, S., Oetken, G., Weber, C. (1999): Zur Human- und Ökotoxizität von Pestiziden, die im Bananenanbau verwendet werden, Pestizid Aktions-Netzwerk e.V. (PAN Germany), Hamburg, Germany

[14] US EPA (2013): Technical Overview of Ecological Risk Assessment Analysis Phase: Ecological Effects Characterization, U.S. Environmental Protection Agency, Washington, DC https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-0

PAN International used these criteria for the identification of endocrine disrupting chemicals and included pesticides which are classified in Regulation 1272/2008/EC as carcinogenic category 2 *and* toxic for reproduction category 2 as endocrine disruptors.

Sources used:

EC (2000): Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption – preparation of a candidate list of substances as a basis for priority setting, European Commission, Delft

EC (2004): Commission Staff Working Document SEC (2004) 1372 on implementation of the Community Strategy for Endocrine Disrupters – a range of substances suspected of interfering with the hormone systems of humans and wildlife (COM (1999) 706), European Commission, Brussels

EC (2007): Commission staff working document on the implementation of the "Community Strategy for Endocrine Disrupters" – a range of substances suspected of interfering with the hormone systems of humans and wildlife (COM (1999) 706), (COM (2001) 262) and (SEC (2004) 1372). SEC(2007) 1635. European Commission (EC). Brussels, 30.11.2007

EC (2008-2016): Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006. Official Journal of the European Union L 353/1 and its amendments

EC (2009): Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC. Official Journal of the European Union, L 309, 24.11.2009

International Regulations

The **Stockholm Convention** aims at the global elimination of Persistent Organic Pollutants (POPs), some of the most unwanted chemicals in the world. POPs are toxic, bioaccumulative, highly persistent, capable of long-range transport and pose a global threat to living beings, especially in the Arctic and Antarctic regions where they biomagnify. All marketed pesticides formally listed under the Stockholm Convention or meeting the criteria of the Stockholm Convention are on the PAN HHP list.

The **Rotterdam Convention** on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade regulates the exchange of information in international trade on certain hazardous pesticides (active ingredients and formulations). All pesticides formally listed under the Rotterdam Convention are on the PAN HHP list.

Certain pesticide formulations are included in Annex 3 of the Rotterdam Convention as Severely Hazardous Pesticide Formulations (SHPFs). It is important to note that active ingredients in these SHPFs are included in the PAN list even though they are regulated only in specific formulations. These active ingredients are identified in the list.

The **Montreal Protocol** on Substances that Deplete the Ozone Layer is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. Currently, there is one pesticide listed as an ozone depleting chemical. This pesticide (methyl bromide) is on the PAN list of HHP.

Sources used:

Website of the Stockholm Convention at http://www.pops.int; Website of the Rotterdam Convention at http://www.pic.int; Website of Montreal Protocol at http://ozone.unep.org

Toxicity to aquatic organisms

The U.S. EPA Office of Pesticide Programs summarises the toxicity of pesticides to certain species groups. The ecological effect characterisation uses a three to five-step scale.[15] Pesticides characterised as *very highly toxic to aquatic organisms*, have a lethal or environmental concentration LC/EC50 [48h] of < 0.1mg/l. These pesticides are listed in the PAN HHP list ***IF*** they are also persistent or bioaccumulative.

Source used:

Lewis KA, Tzilivakis J, Warner D & Green A (2016): An international database for pesticide risk assessments and management. Human and Ecological Risk Assessment: An International Journal, In Press. doi:10.1080/10807039.2015.1133242

Ecosystem services – pollination by bees

The U.S. EPA Office of Pesticide Programs, after reviewing individual toxicity or ecological effect studies for a pesticide, summarises the toxicity of pesticides to certain species groups. In developing its ecological effect characterisation, EPA uses a three-step scale[16] of toxicity categories to classify pesticides based on bee toxicity data. All pesticides classified as 'highly toxic to bees' are listed in the PAN HHP list.

Source used:

Lewis KA, Tzilivakis J, Warner D & Green A (2016): An international database for pesticide risk assessments and management. Human and Ecological Risk Assessment: An International Journal, In Press. doi:10.1080/10807039.2015.1133242

Method applied to identify highly hazardous pesticides

The classification systems and lists mentioned above have been integrated by PAN in a relational pesticide database consisting of numerous tables representing the classification systems and lists. Either CAS numbers or unique identification numbers (IDs) are used to match fields between the tables. Data were usually imported from Excel, Access or PDF files. A table (list) of all pesticides is linked to all tables containing classification systems and lists mentioned above, and this table/list was searched for the criteria defining highly hazardous pesticides. Pesticides which are considered to be 'obsolete' by the WHO/IPCS were omitted, except any obsolete pesticides which were found on current authorisation lists.

The Pesticide Properties Database (by Lewis et al.) has been used to identify pesticides with the characteristics of being toxic to bees (LD50 <2 microgram/bee); persistent, bioaccumulative and/or highly toxic to aquatic organisms (LC/EC50 *Daphnia* spp. < 0.1 mg/l).

[15] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-0

[16] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-0

Evolution of the PAN List of Highly Hazardous Pesticides

The number of active ingredients on the PAN HHP List changes over time. The reasons for changes are mainly changes in classifications made by organisations referred to in this list such as WHO, EU, EPA or IARC. In 2010, for example, more pesticides were classified as toxic to bees and as persistent. In 2013, numerous substances, which are not agricultural pesticides or obsolete, were deleted. Even though 12 pesticides were added to the 2015 version due to new data or classification changes the June 2015 version was significantly shorter than versions before 2014. The main reasons were: (a) the deletion of those pesticides classified as “possible carcinogens”, and (b) the required combination of two of the three Persistence, Bioaccumulative and Toxic characteristics (i.e. P&B; B&T or P&T).

Pesticides *added* to the PAN HHP List since January 2009

2009-2011

Alanycarb
Amidosulfuron
Asulam, sodium salt
Benfuracarb
Bensulide
beta-HCH; beta-BCH
Bioresmethrin
Blasticidin-S
Borax; disodium tetraborate decahydrate
Boric acid
Carbosulfan
Chlordimeform
Chlorphropham
Clopyralid
Cyhalothrin
Cyhalothrin, gamma
Diafenthiuron
Dimefuron
Dimoxystrobin
Dinotefuran
Diquat dichloride
Dithianon
E-Phosphamidon
EPTC
Ethaboxam
Ethirimol
Fenchlorazole-ethyl
Fenothiocarb
Fenpropidin
Flufenoxuron
Glufosinate-ammonium
Lenacil
Metazachlor
Metobromuron
Metoxuron
Metsulfuron-methyl
Milbemectin
Naled
Napropamide
Nicosulfuron
Nitenpyram
Nitrobenzene
Oxycarboxin
Penconazole
Pentachlorbenzene
Pirimiphos-methyl
Prallethrin
Profenofos
Pyraclofos
Pyrazophos
Pyridaben
Pyridiphenthion
Pyrifenox
Quinmerac
Rotenone
Silafluofen
Sintofen
Temephos
Tralomethrin
Tributyltin compounds
Tridiphane
Validamycin
XMC

Since 2011

Penthiopyrad
Penflufen
Sedaxane
o-phenylphenol
Group: Paraffin oils, Mineral oils
Paraffin oil (see group table)
Isopyrazam
Amisulbrom
Spinetoram
Pyridalyl
Penflufen
Isopyrazam
Ipconazole
Penthiopyrad
Sedaxane
Fluxapyroxad
Metazachlor
Fuberidazole
Oxadiargyl
Zinc phosphide
Cyflufenamid

Since June 2013

Magnesium phosphide
Proquinazid
Aclonifen
Imiprothrin
Sulfoxaflor
Climbazole
Metaflumizone
Aminocyclopyrachlor

Since November 2013

Anthraquinone
Bromoxynil heptanoate
Bromoxynil octanoate
Chlorantraniliprole
Chlorfluazuron
Copper (II) hydroxide
Fluazolate
Flumetralin
Halfenprox
Prothiofos
Pyrazachlor
Tolfenpyrad

Since June 2014

Glyphosate

Since June 2015

Pendimethalin
Triflumizole
Group: Borax, borate salts *(see table Grouped Pesticides below)*

Pesticides *deleted* from the PAN HHP List since January 2009

2009-2011

2,4-dichlorophenol
Bacillus subtilis GBO3
Chlordimeform hydrochloride
Chlorsulfuron
Sulfosulfuron

Since 2011

1,2,4-triazole
2,4,6-trichlorophenol
2,6-Dichlorbenzamid
Aniline
Azobenzene
Bis (chloroethyl) ether
Chlorbenside
Coconut diethanolamide
Dichloro acetic acid
Dimethoxane
Doxorubicin
Heptachlor epoxide
Hydrazine
Isophorone
Mepronil
Methylene chloride
P-chloroaniline
Pentachlorbenzene
Picloram, diethanolamine salt
piperonyl butoxid
Trichlorophenol
Tridiphane

Since June 2013

2,4,5-T (2,4,5-trichlorophenoxy acetic acid)
Aldrin
Binapacryl
Chlordimeform
Chlorobenzilate
Cholecalciferol; Vitamin D3
Dieldrin
Dinoseb
Endrin
Heptachlor
Mirex
Toxaphene
Metobromuron
Chlordecone
8-hydroxyquinoline
Oxadiargyl
Methyl isothiocyanate

Since November 2013

2,4,5-T, butyric acid
2,4,5-trichlorophenol
2,4-D
2,4-DP, isooctyl ester
3-CPA
Acifluorfen, sodium salt
Aclonifen
Allethrin; Bioallethrin
Amidosulfuron
Aminocyclopyrachlor
Aminopyralid
Amitraz
Asulam
Asulam, sodium salt
Azoxystrobin
Benfluralin
Bentazone
Boscalid; Nicobifen; BAS 510 F
Bromacil
Bromuconazole
Buprofezin
Captan
Chlorpropham
Chlozolinate
Cinidon-ethyl
Clodinafop-propargyl
Clofencet
Clofentezine
Clopyralid
Cumyluron
Cyanazine
Cyproconazole
Cyromazine
Dacthal (DCPA); Chlorthal-dimethyl
Dichlobenil
Dichlorophene
Dichlorprop-P
Dicofol
Difenoconazole
Dimefuron
Dimethenamid
Dimethipin
Dithianon
Esbiothrin; S-Bioallethrin
Ethaboxam
Ethalfluralin
Ethiozin
Ethiprole
Ethofumesate
Fenbuconazole
Fenpropidin
Flonicamid
Fluazinam
Fludioxonil
Fluometuron
Fluopicolide
Flutolanil
Fluxapyroxad
Forchlorfenuron
Fuberidazole
Furfural; 2-furaldehyde
Glyphosate trimesium
Hexachloroethane
Hexaconazole
Hydramethylnon
Hydrogen cyanamide
Imazaquin
Iodomethane
Ipconazole
Isoproturon
Isoxaben
Lactofen
Lenacil
MCPA
MCPB
MCPP
Mecoprop-P
Mercaptobenzothiazole, 2-
Metaldehyde
Metazachlor
Metconazole
Methylphenol, 3-; Meta-Cresol
Metolachlor
Metoxuron
Metrafenone
Metronidazole
Metsulfuron-methyl
Myclobutanil
Napropamide
Nicosulfuron
Norflurazon
O-phenylphenol
Orthosulfamuron
Oxadixyl
Oxycarboxin
Paclobutrazol
p-Dichlorobenzene; Paradichlorobenzene
Penconazole
Pendimethalin
Penflufen
Penoxsulam
Penthiopyrad
Piperonyl butoxide
Polyhexamethylene biguanide (PHMB)
Prochloraz
Prodiamine
Prometryn
Propanil
Propazine
Propiconazole
Proquinazid
Prosulfocarb
Pyrasulfotole
Pyrethrins
Pyrifenox
Pyrimethanil
Pyrithiobac-sodium
Pyroxasulfone
Quinmerac
Quintozene; (PCNB)
Silthiofam
Simazine
Sintofen
S-Metolachlor
Tebuconazole
Tebufenpyrad
Tembotrione
Thiabendazole
Thiazopyr
Topramezone
Tralkoxydim
Triadimefon
Triadimenol
Triasulfuron
Tribenuron methyl
Tribufos
Triclosan
Tricyclazole
Triflusulfuron-methyl
Triforine
Triticonazole
Uniconazole

Since June 2014

Fluopyram

Since June 2015

Imazethapyr

Explanatory notes
regarding the table of active ingredients

WHO Ia:	Extremely hazardous (Class 1a) according to World Health Organisation
WHO Ib:	Highly hazardous (Class 1b) according to World Health Organisation
H330	'*Fatal if inhaled'*, hazard classification according to the Globally Harmonised System (GHS)
max = 1	This active ingredient meets at least one criteria in this Group
EPA carc	Human carcinogen according to EPA
IARC carc	Human carcinogen according to IARC
EU GHS (1A, 1B):	Known or presumed human carcinogens (1A or 1B) according to EU GHS Regulation 1272/2008/EC
EPA prob/likel carc	Probable/ Likely carcinogen according to EPA
IARC prob carc	Probable carcinogen according to IARC
EU GHS (2):	Suspected human carcinogen (Cat. 2) according to EU GHS Regulation 1272/2008/EC
EU GHS muta (1A, 1B)	Substances known to induce heritable mutations or to be regarded as if they induce heritable mutations in the germ cells of humans. Substances known to induce heritable mutations in the germ cells of humans' (Category 1A or 1B) according to EU Regulation 1272/2008/EC
EU GHS repro (1A, 1B):	Known or presumed human reproductive toxicant according to EU GHS Regulation 1272/2008/EC
EU EDC (1) or C2 & R2 GHS:	Endocrine disruptor or potential endocrine disruptor according to EU Category 1 or pesticides classified GHS Carcinogen Category 2 AND EU Reproductive Category 2
Very bio acc:	Very bioaccumulative (BCF >5000) or Kow logP >5 (BCF values supersede Kow logP data)
Very persistent water, soil or sediment:	Very persistent in water (half-life > 60 days), soils or sediments (half-life > 180 days)
Very toxic to aq. Organism:	Very toxic to aquatic organisms (Acute LC/EC50 <0,1 mg/l for Daphnia species)
Highly toxic bees:	Hazard to ecosystem services – Highly toxic to bees (<2 µg/bee) according to U.S. EPA as listed by FOOTPRINT data
Montr Prot:	Ozone depleting chemical according to the Montreal Protocol
PIC:	Listed in Annex III of the Rotterdam Convention
POP:	Listed in Annex III of the Stockholm Convention

Grouped Pesticides

Some pesticides are grouped in the list as follows:

Group/ pesticides	CAS Number
Arsen and its coumpounds	
Arsenic pentoxide	1303-28-2
Cacodylic acid; dimethylarsinic acid	75-60-5
MSMA	2163-80-6
Sodium arsenate	13464-38-5
Cacolydate; sodium dimethylarsinate	124-65-2
Chromated copper arsenate; CCA	75-60-5
Arsenic trioxide	1327-53-3
Calcium arsenate	7778-44-1
Copper arsenate	10103-61-4
Lead arsenate	7784-40-9
Sodium arsenite	7784-46-5
Borax; Borate salts	
Borax, disodium octaborate anhydrous	12008-41-2
Borax, disodium octaborate tetrahydrate	12280-03-4
Borax, disodium tetraborate decahydrate	1303-96-4
DNOC and its salts	
DNOC, ammonium salt	2980-64-5
DNOC, potassium salt	5787-96-2
DNOC, sodium salt	2312-76-7
DNOC	534-52-1
Mercury and its compounds	
Mercuric chloride	7487-94-7
Mercuric oxide	21908-53-2
Chloromethoxypropylmercuric acetate; CPMA	1319-86-4
Diphenylmercurydodecenylsuccinate; PMDS	27236-65-3
Phenylmercuric oleate; PMO	104-68-9
Phenylmercury acetate; PMA	62-38-4
Tributyltin compounds	
Tributyltin oxide	56-35-9
Tributyltin fluoride	1983-10-4
Tributyltin methacrylate	2155-70-6
Tributyltin benzoate	4342-36-3
Tributyltin chloride	1461-22-9
Tributyltin linoleate	24124-25-2
Tributyltin naphthenate	85409-17-2
Paraffin oils; mineral oils containing > 3% Dimethylsulfoxid (DMSO)	
Paraffin oil	64741-88-4
Paraffin oil	64741-89-5
Paraffin oil	64741-97-5
Paraffin oil	64742-46-7
Paraffin oil	64742-54-7
Paraffin oil	64742-55-8
Paraffin oil	64742-65-0
Paraffin oil	72623-86-0
Paraffin oil	97862-82-3

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					Group 1: Acute Toxicity				Group 2: Long term effects									Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
0					27	48	48		1	3	12	7	73	4	26	52		21	15	28	115		1	25		7	
1	542-75-6	1,3-dichloropropene		1				0					1				1					0					0
2	94-82-6	2,4-DB		1				0								1	1					0					0
3	71751-41-2	Abamectin		2			1	1									0				1	1					0
4	30560-19-1	Acephate		1				0									0				1	1					0
5	34256-82-1	Acetochlor		1				0								1	1					0					0
6	101007-06-1	Acrinathrin		1				0									0				1	1					0
7	107-02-8	Acrolein		1		1	1	1									0					0					0
8	15972-60-8	Alachlor		2				0								1	1					0		1			1
9	83130-01-2	Alanycarb		1				0									0				1	1					0
10	116-06-3	Aldicarb		3	1		1	1									0				1	1		1			1
11	319-84-6	alpha-BHC; alpha-HCH		1				0									0					0				1	1
12	96-24-2	Alpha-chlorohydrin		1		1		1									0					0					0
13	20859-73-8	Aluminum phosphide		2			1	1									0				1	1					0
14	348635-87-0	Amisulbrom		1				0									0		1	1		1					0
15	61-82-5	Amitrole		1				0								1	1					0					0
16	90640-80-5	Anthracene oil		1				0			1						1					0					0
17	84-65-1	Anthraquinone		1				0					1				1					0					0
18	7778-39-4	Arsen and its compounds	x	1				0	1	1	1						1					0					0
19	1912-24-9	Atrazine		1				0								1	1					0					0
20	68049-83-2	Azafenidin		1				0							1		1					0					0
21	35575-96-3	Azamethiphos		1				0									0				1	1					0
22	2642-71-9	Azinphos-ethyl		2		1		1									0				1	1					0

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					Group 1: Acute Toxicity				Group 2: Long term effects									Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
23	86-50-0	Azinphos-methyl		3		1	1	1									0				1	1		1			1
24	41083-11-8	Azocyclotin		2			1	1									0	1		1		1					0
25	22781-23-3	Bendiocarb		1				0									0				1	1					0
26	82560-54-1	Benfuracarb		1				0									0				1	1					0
27	17804-35-2	Benomyl		2				0						1	1		1					0		1	X		1
28	741-58-2	Bensulide		1				0									0				1	1					0
29	177406-68-7	Benthiavalicarb-isopropyl		1				0					1				1					0					0
30	68359-37-5	Beta-cyfluthrin; Cyfluthrin		2		1	1	1									0				1	1					0
31	319-85-7	beta-HCH; beta-BCH		2				0								1	1					0				1	1
32	82657-04-3	Bifenthrin		2				0								1	1				1	1					0
33	28434-01-7	Bioresmethrin		1				0									0				1	1					0
34	2079-00-7	Blasticidin-S		1		1		1									0					0					0
35	1303-96-4	Borax; Borate salts	x	1				0							1		1					0					0
36	10043-35-3	Boric acid		1				0							1	1	1					0					0
37	56073-10-0	Brodifacoum		2	1		1	1							1		1					0					0
38	28772-56-7	Bromadiolone		2	1		1	1							1		1					0					0
39	63333-35-7	Bromethalin		2	1			1									0	1		1		1					0
40	1689-84-5	Bromoxynil		1			1	1									0					0					0
41	56634-95-8	Bromoxynil heptanoate		1				0									0	1		1		1					0
42	1689-99-2	Bromoxynil octanoate		1				0									0	1		1		1					0
43	23184-66-9	Butachlor		1				0					1				1					0					0
44	34681-10-2	Butocarboxim		1				0									0				1	1					0
45	34681-23-7	Butoxycarboxim		1		1		1									0					0					0

PAN International List of Highly Hazardous Pesticides - December 2016

					Group 1: Acute Toxicity				Group 2: Long term effects									Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
46	95465-99-9	Cadusafos		2		1		1									0		1	1	1	1					0
47	2425-06-1	Captafol		3	1			1			1	1	1				1					0		1			1
48	63-25-2	Carbaryl		2				0					1			1	1				1	1					0
49	10605-21-7	Carbendazim		1				0						1	1		1					0					0
50	1563-66-2	Carbofuran		3		1	1	1									0				1	1		1	X		1
51	55285-14-8	Carbosulfan		2			1	1									0				1	1					0
52	2439-01-2	Chinomethionat; Oxythioquinox		1				0					1				1					0					0
53	500008-45-7	Chlorantraniliprole		1				0									0		1	1		1					0
54	57-74-9	Chlordane		3				0					1			1	1	1				1		1		1	1
55	54593-83-8	Chlorethoxyphos		2	1			1									0				1	1					0
56	122453-73-0	Chlorfenapyr		1				0									0				1	1					0
57	470-90-6	Chlorfenvinphos		2		1		1									0				1	1					0
58	71422-67-8	Chlorfluazuron		1				0									0	1		1		1					0
59	24934-91-6	Chlormephos		1	1			1									0					0					0
60	67-66-3	Chloroform		1				0					1				1					0					0
61	3691-35-8	Chlorophacinone		1	1			1									0					0					0
62	76-06-2	Chloropicrin		1			1	1									0					0					0
63	1897-45-6	Chlorothalonil		2			1	1					1				1					0					0
64	15545-48-9	Chlorotoluron		1				0								1	1					0					0
65	2921-88-2	Chlorpyrifos		1				0									0				1	1					0
66	5598-13-0	Chlorpyrifos-methyl		1				0									0				1	1					0
67	38083-17-9	Climbazole		1				0									0				1	1					0
68	210880-92-5	Clothianidin		1				0									0				1	1					0

PAN International List of Highly Hazardous Pesticides - December 2016

					Group 1: Acute Toxicity				Group 2: Long term effects									Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
69	20427-59-2	Copper (II) hydroxide		2			1	1									0		1	1		1					0
70	56-72-4	Coumaphos		2		1	1	1							1		1					0					0
71	5836-29-3	Coumatetralyl		1		1		1									0					0					0
72	8001-58-9	Creosote		1				0			1	1	1				1					0					0
73	180409-60-3	Cyflufenamid		1				0					1				1					0					0
74	68085-85-8	Cyhalothrin		1				0									0				1	1					0
75	76703-62-3	Cyhalothrin, gamma		1				0									0				1	1					0
76	13121-70-5	Cyhexatin		1				0									0	1		1		1					0
77	52315-07-8	Cypermethrin		1				0									0				1	1					0
78	67375-30-8	Cypermethrin, alpha		1				0									0				1	1					0
79	65731-84-2	Cypermethrin, beta		1				0									0				1	1					0
80	1596-84-5	Daminozide		1				0					1				1					0					0
81	50-29-3	DDT		3				0					1			1	1		1	1		1		1		1	1
82	52918-63-5	Deltamethrin		2				0								1	1				1	1					0
83	919-86-8	Demeton-S-methyl		2		1		1									0				1	1					0
84	80060-09-9	Diafenthiuron		1				0									0				1	1					0
85	333-41-5	Diazinon		2				0				1					1				1	1					0
86	62-73-7	Dichlorvos; DDVP		2		1	1	1									0				1	1					0
87	51338-27-3	Diclofop-methyl		1				0					1				1					0					0
88	141-66-2	Dicrotophos		2		1		1									0				1	1					0
89	56073-07-5	Difenacoum		2	1			1									0	1				1					0
90	104653-34-1	Difethialone		2	1		1	1							1		1					0					0
91	60-51-5	Dimethoate		1				0									0				1	1					0

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					Group 1: Acute Toxicity				Group 2: Long term effects										Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
92	149961-52-4	Dimoxystrobin		2				0								1	1		1	1		1					0
93	39300-45-3	Dinocap		1				0							1		1					0					0
94	165252-70-0	Dinotefuran		1				0									1				1	1					0
95	1420-07-1	Dinoterb		2		1		1							1		1					0					0
96	82-66-6	Diphacinone		1	1			1									1					0					0
97	85-00-7	Diquat dibromide		1			1	1									1					0					0
98	4032-26-2	Diquat dichloride		1			1	1									1					0					0
99	298-04-4	Disulfoton		1	1			1									1					0					0
100	330-54-1	Diuron		1				0					1				1					0					0
101	534-52-1	DNOC and its salts	x	2		1	1	1									1					0		1			1
102	17109-49-8	Edifenphos		1		1		1									1					0					0
103	115-29-7	Endosulfan		2			1	1									1					0		1		1	1
104	297-99-4	E-Phosphamidon		1	1			1									1					0					0
105	106-89-8	Epichlorohydrin		1				0			1	1	1			1	1					0					0
106	2104-64-5	EPN		2	1			1									1				1	1					0
107	133855-98-8	Epoxiconazole		1				0					1		1	1	1					0					0
108	66230-04-4	Esfenvalerate		1				0									1				1	1					0
109	29973-13-5	Ethiofencarb		1		1		1									1					0					0
110	23947-60-6	Ethirimol		1				0									1				1	1					0
111	13194-48-4	Ethoprophos; Ethoprop		2	1		1	1					1				1					0					0
112	106-93-4	Ethylene dibromide; 1,2-dibromoethane		2				0			1	1	1			1	1					0		1			1
113	107-06-2	Ethylene dichloride; 1,2-Dichloroethane		2				0			1		1				1					0		1			1

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	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
114	75-21-8	Ethylene oxide		2				0		1	1			1			1					0		1			1
115	96-45-7	Ethylene thiourea		1				0					1		1	1	1					0					0
116	80844-07-1	Etofenprox; Ethofenprox		1				0									0		1	1	1	1					0
117	52-85-7	Famphur		1		1		1									0					0					0
118	22224-92-6	Fenamiphos		2		1	1	1									0				1	1					0
119	60168-88-9	Fenarimol		1				0								1	1					0					0
120	120928-09-8	Fenazaquin		1				0									0				1	1					0
121	13356-08-6	Fenbutatin-oxide		2			1	1									0		1	1		1					0
122	103112-35-2	Fenchlorazole-ethyl		1				0			1						1					0					0
123	122-14-5	Fenitrothion		2				0								1	1				1	1					0
124	72490-01-8	Fenoxycarb		2				0					1				1				1	1					0
125	39515-41-8	Fenpropathrin		2			1	1									0				1	1					0
126	55-38-9	Fenthion		1				0									0				1	1					0
127	900-95-8	Fentin acetate; Triphenyltin acetate		2			1	1								1	1					0					0
128	76-87-9	Fentin hydroxide; Triphenyltin hydroxide		2			1	1					1			1	1					0					0
129	51630-58-1	Fenvalerate		1				0									0				1	1					0
130	120068-37-3	Fipronil		1				0									0				1	1					0
131	90035-08-8	Flocoumafen		2	1		1	1							1		1					0					0
132	69806-50-4	Fluazifop-butyl		1				0							1		1					0					0
133	174514-07-9	Fluazolate		1				0									0	1		1		1					0
134	70124-77-5	Flucythrinate		2		1		1									0				1	1					0
135	101463-69-8	Flufenoxuron		1				0									0	1		1		1					0

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136	62924-70-3	Flumetralin		1				0									0	1		1		1					0
137	103361-09-7	Flumioxazin		1				0							1		1					0					0
138	640-19-7	Fluoroacetamide		2		1		1									0					0		1			1
139	85509-19-9	Flusilazole		1				0							1		1					0					0
140	117337-19-6	Fluthiacet-methyl		1				0					1				1					0					0
141	133-07-3	Folpet		1				0					1				1					0					0
142	50-00-0	Formaldehyde		1				0		1			1				1					0					0
143	22259-30-9	Formetanate		2		1	1	1									0				1	1					0
144	98886-44-3	Fosthiazate		1				0									0				1	1					0
145	65907-30-4	Furathiocarb		1		1	1	1									0					0					0
146	121776-33-8	Furilazole		1				0					1				1					0					0
147	77182-82-2	Glufosinate-ammonium		1				0							1		1					0					0
148	1071-83-6	Glyphosate		1				0				1					1					0					0
149	111872-58-3	Halfenprox		1				0									0	1		1		1					0
150	69806-40-2	Haloxyfop-methyl (unstated stereochemistry)		1				0					1				1					0					0
151	23560-59-0	Heptenophos		2		1		1									0				1	1					0
152	118-74-1	Hexachlorobenzene		4	1			1			1		1			1	1	1				1		1		1	1
153	86479-06-3	Hexaflumuron		1				0									0				1	1					0
154	608-73-1	Hexchlorocyclohexane; BHC mixed isomers		2				0					1			1	1					0		1			1
155	78587-05-0	Hexythiazox		1				0					1				1					0					0
156	35554-44-0	Imazalil		1				0					1				1					0					0
157	138261-41-3	Imidacloprid		1				0									0				1	1					0

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158	72963-72-5	Imiprothrin		1				0									0				1	1					0
159	173584-44-6	Indoxacarb		1				0									0				1	1					0
160	1689-83-4	Ioxynil		1				0								1	1					0					0
161	36734-19-7	Iprodione		1				0					1				1					0					0
162	140923-17-7	Iprovalicarb		1				0					1				1					0					0
163	881685-58-1	Isopyrazam		2				0					1				1		1	1		1					0
164	141112-29-0	Isoxaflutole		1				0					1				1					0					0
165	18854-01-8	Isoxathion		2		1		1									0				1	1					0
166	143390-89-0	Kresoxim-methyl		1				0					1				1					0					0
167	91465-08-6	Lambda-cyhalothrin		3			1	1								1	1				1	1					0
168	58-89-9	Lindane		3				0								1	1				1	1		1		1	1
169	330-55-2	Linuron		1				0							1	1	1					0					0
170	103055-07-8	Lufenuron		1				0									0	1	1	1		1					0
171	12057-74-8	Magnesium phosphide		1			1	1									0					0					0
172	121-75-5	Malathion		2				0				1					1				1	1					0
173	8018-01-7	Mancozeb		1				0					1			1	1					0					0
174	12427-38-2	Maneb		1				0					1			1	1					0					0
175	2595-54-2	Mecarbam		1		1		1									0					0					0
176	110235-47-7	Mepanipyrim		1				0					1				1					0					0
177	7439-97-6	Mercury and its compounds	x	2			1	1									0					0		1			1
178	139968-49-3	Metaflumizone		1				0									0				1	1					0
179	137-41-7	Metam-potassium		1				0					1				1					0					0
180	137-42-8	Metam-sodium		1				0					1			1	1					0					0

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181	18691-97-9	Methabenzthiazuron		1				0									0				1	1					0
182	10265-92-6	Methamidophos		3		1	1	1									0				1	1		1	X		1
183	950-37-8	Methidathion		2		1		1									0				1	1					0
184	2032-65-7	Methiocarb		2		1		1									0				1	1					0
185	16752-77-5	Methomyl		2		1		1									0				1	1					0
186	72-43-5	Methoxychlor		1				0								1	1					0					0
187	74-83-9	Methyl bromide		1				0									0					0	1				1
188	9006-42-2	Metiram		1				0					1			1	1					0					0
189	21087-64-9	Metribuzin		1				0								1	1					0					0
190	7786-34-7	Mevinphos		2	1			1									0				1	1					0
191	136-45-8	MGK 326		1				0					1				1					0					0
192	51596-10-2	Milbemectin		1				0									0				1	1					0
193	2212-67-1	Molinate		1				0								1	1					0					0
194	71526-07-3	MON 4660; AD 67		1				0					1				1					0					0
195	6923-22-4	Monocrotophos		3		1	1	1									0				1	1		1			1
196	300-76-5	Naled		1				0									0				1	1					0
197	54-11-5	Nicotine		1		1		1									0					0					0
198	150824-47-8	Nitenpyram		1				0									0				1	1					0
199	1929-82-4	Nitrapyrin		1				0					1				1					0					0
200	98-95-3	Nitrobenzene		1				0							1	1	1					0					0
201	1113-02-6	Omethoate		3		1		1								1	1				1	1					0
202	19044-88-3	Oryzalin		1				0					1				1					0					0
203	19666-30-9	Oxadiazon		1				0					1				1					0					0

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204	23135-22-0	Oxamyl		2		1	1	1									0				1	1					0
205	301-12-2	Oxydemeton-methyl		2		1		1									0				1	1					0
206	42874-03-3	Oxyfluorfen		1				0					1				1					0					0
207	64741-88-4	Paraffin oils; mineral oils	x	1				0			1						1					0					0
208	1910-42-5	Paraquat dichloride		1			1	1									0					0					0
209	56-38-2	Parathion		3	1			1									0				1	1		1			1
210	298-00-0	Parathion-methyl		2	1		1	1									0					0		1	X		1
211	87-86-5	PCP; Pentachlorphenol		3		1	1	1					1			1	1					0		1			1
212	40487-42-1	Pendimethalin		1				0									0	1	1			1					0
213	52645-53-1	Permethrin		2				0					1				1				1	1					0
214	2597-03-7	Phenthoate		1				0									0				1	1					0
215	298-02-2	Phorate		2	1			1									0				1	1					0
216	732-11-6	Phosmet		1				0									0				1	1					0
217	13171-21-6	Phosphamidon		3	1			1									0				1	1		1	X		1
218	7803-51-2	Phosphine		1			1	1									0					0					0
219	1918-02-1	Picloram		1				0								1	1					0					0
220	23103-98-2	Pirimicarb		2				0					1				1		1	1		1					0
221	29232-93-7	Pirimiphos-methyl		1				0									0				1	1					0
222	299-45-6	Potasan		1			1	1									0					0					0
223	23031-36-9	Prallethrin		1				0									0				1	1					0
224	32809-16-8	Procymidone		1				0					1			1	1					0					0
225	41198-08-7	Profenofos		1				0									0				1	1					0
226	139001-49-3	Profoxydim		1				0								1	1					0					0

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227	1918-16-7	Propachlor		1				0					1				1					0					0
228	2312-35-8	Propargite		2				0					1				1	1		1		1					0
229	31218-83-4	Propetamphos		1		1		1									0					0					0
230	114-26-1	Propoxur		2				0					1				1				1	1					0
231	75-56-9	Propylene oxide, Oxirane		1				0			1		1	1			1					0					0
232	23950-58-5	Propyzamide		1				0					1				1					0					0
233	34643-46-4	Prothiofos		1				0									0	1		1		1					0
234	123312-89-0	Pymetrozine		1				0					1				1					0					0
235	77458-01-6	Pyraclofos		1				0									0				1	1					0
236	129630-19-9	Pyraflufen-ethyl		1				0					1				1					0					0
237	6814-58-0	Pyrazachlor		1				0					1				1					0					0
238	13457-18-6	Pyrazophos		1				0									0				1	1					0
239	108-34-9	Pyrazoxon		1			1	1									0					0					0
240	96489-71-3	Pyridaben		1				0									0				1	1					0
241	179101-81-6	Pyridalyl		1				0									0	1	1	1		1					0
242	119-12-0	Pyridiphenthion		1				0									0				1	1					0
243	13593-03-8	Quinalphos		2				0								1	1				1	1					0
244	2797-51-5	Quinoclamine		1				0									0				1	1					0
245	124495-18-7	Quinoxyfen		1				0									0	1		1		1					0
246	119738-06-6	Quizalofop-p-tefuryl		1				0							1		1					0					0
247	10453-86-8	Resmethrin		2				0					1			1	1				1	1					0
248	83-79-4	Rotenone		1				0									0				1	1					0
249	874967-67-6	Sedaxane		1				0					1				1					0					0

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250	105024-66-6	Silafluofen		2				0							1		1				1	1					0
251	128-04-1	Sodium dimethyl dithio carbamate		1				0					1				1					0					0
252	62-74-8	Sodium fluoroacetate (1080)		1	1		1	1									0					0					0
253	187166-15-0	Spinetoram		1				0									0				1	1					0
254	168316-95-8	Spinosad		1				0									0				1	1					0
255	148477-71-8	Spirodiclofen		1				0					1				1					0					0
256	57-24-9	Strychnine		1		1		1									0					0					0
257	3689-24-5	Sulfotep		1	1			1									0					0					0
258	946578-00-3	Sulfoxaflor		1				0									0				1	1					0
259	21564-17-0	TCMTB		1			1	1									0					0					0
260	96182-53-5	Tebupirimifos		2	1			1									0		1	1		1					0
261	79538-32-2	Tefluthrin		2		1		1									0				1	1					0
262	3383-96-8	Temephos		1				0									0				1	1					0
263	149979-41-9	Tepraloxydim		1				0								1	1					0					0
264	13071-79-9	Terbufos		1	1			1									0					0					0
265	886-50-0	Terbutryn		1				0								1	1					0					0
266	2593-15-9	Terrazole; Etridiazole		1				0					1				1					0					0
267	22248-79-9	Tetrachlorvinphos		2				0					1				1				1	1					0
268	112281-77-3	Tetraconazole		1				0					1				1					0					0
269	7696-12-0	Tetramethrin		1				0									0				1	1					0
270	111988-49-9	Thiacloprid		1				0					1				1					0					0
271	153719-23-4	Thiamethoxam		1				0									0				1	1					0
272	59669-26-0	Thiodicarb		2				0					1				1				1	1					0

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					Group 1: Acute Toxicity				Group 2: Long term effects										Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
273	39196-18-4	Thiofanox		2		1		1									0				1	1					0
274	640-15-3	Thiometon		2		1		1									0				1	1					0
275	23564-05-8	Thiophanate-methyl		1				0					1				1					0					0
276	62-56-6	Thiourea		1				0								1	1					0					0
277	137-26-8	Thiram in formulations with benomyl and carbofuran		2				0								1	1					0		1	X		1
278	129558-76-5	Tolfenpyrad		1				0									0	1		1		1					0
279	731-27-1	Tolylfluanid		2			1	1					1				1					0					0
280	66841-25-6	Tralomethrin		1				0									0				1	1					0
281	2303-17-5	Tri-allate		1				0									0		1	1		1					0
282	24017-47-8	Triazophos		1		1		1									0					0					0
283	nocas 8	Tributyltin compounds		2				0								1	1					0		1			1
284	52-68-6	Trichlorfon		2				0								1	1				1	1					0
285	81412-43-3	Tridemorph		1				0							1		1					0					0
286	99387-89-0	Triflumizole		1				0							1		1					0					0
287	1582-09-8	Trifluralin		2				0								1	1	1				1					0
288	37248-47-8	Validamycin		1				0									0				1	1					0
289	2275-23-2	Vamidothion		2		1		1									0				1	1					0
290	50471-44-8	Vinclozolin		1				0							1	1	1					0					0
291	81-81-2	Warfarin		2		1	1	1							1		1					0					0
292	2655-14-3	XMC		1				0									0				1	1					0
293	52315-07-8z	zeta-Cypermethrin		2		1		1									0				1	1					0
294	1314-84-7	Zinc phosphide		1		1		1									0					0					0

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					Group 1: Acute Toxicity				Group 2: Long term effects									Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	**Grouped (see page 21)**	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A ,1B)	EU EDC (1) or C2 & R2 GHS	**max = 1**	very bio acc	very pers water, soil or sediment	very toxic to aq. organism	highly toxic bees	**max = 1**	Montr Prot	PIC	See note below the table	POP	**max = 1**
295	12122-67-7	Zineb		**1**				**0**								1	**1**					**0**					**0**
296	137-30-4	Ziram		**1**			1	**1**									**0**					**0**					**0**
297	23783-98-4	Z-Phosphamidon		**1**	1			**1**									**0**					**0**					**0**

X: Annex III of the PIC/Rotterdam Convention refers to certain formulations, those chemicals are indicated with an "X".