PAN International List of Highly Hazardous Pesticides

(PAN List of HHPs)

December 2024

Pesticide Action Network International

Impressum

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This 'PAN International List of Highly Hazardous Pesticides' is drafted by PAN Germany for PAN International. The 1st version was published January 2009. Since then criteria had been revised and the list has been updated several times.

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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. The effectiveness of 'safe use' training approaches to highly hazardous pesticides have 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 as well. Accordingly, Reg. 1107/2009 stipulated 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

[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), the Strategic Approach to International Chemicals Management (http://www.saicm.org/) and its successor, the Global Framework on Chemicals (https://www.chemicalsframework.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

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 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 eight criteria. Accordingly, a highly hazardous pesticide is defined as having one or more of the following characteristics:

- **Criterion 1**: Pesticide formulations that meet the criteria of classes Ia or Ib of the WHO Recommended Classification of Pesticides by Hazard; or
- **Criterion 2**: 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
- **Criterion 3**: 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
- **Criterion 4**: 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

[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/

- **Criterion 5**: 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
- **Criterion 6**: Pesticide active ingredients and formulations listed by the Rotterdam Convention in its Annex III; or
- **Criterion 7**: Pesticides listed under the Montreal Protocol; or
- **Criterion 8**: 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.

Driven by these shortcomings and because FAO and WHO didn't come up with an HHP-List, PAN International decided to independently to develop a list of highly hazardous pesticide active ingredients, first published in 2009. This PAN HHP list is built on the JMPM criteria for identifying HHPs, and includes additional hazard criteria based on physical properties data (i.e., persistence) or those used by internationally recognised authorities, such as the GHS (See Table 1). The purpose of including additional hazard criteria from recognised authorities is an effort to overcome the identified shortcomings. One example of a health hazard not addressed by the JMPM HHPs criteria is endocrine disruption. Please see the Explanatory Notes section following Table 1 on the classifications, lists, and sources used by PAN.

2013-2021: 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[7]) 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 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*

[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] 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/

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)."*

Under SAICM, the fourth International Conference on Chemicals Management in 2015 [8] formally recognised HHPs as an Issue of Concern (IoC) and encouraged stakeholders to take concerted action on them.[9]

In September 2020, UNEP published an *Assessment Report on Issues of Concern*,[10] in response to Resolution 4/8 by the United Nations Environment Assembly (UNEA). This report acknowledged that the existing instruments do not comprehensively address the sound management of HHPs at a global scale and that concerted international actions on HHPs are urgently needed and require for example, an international framework of sound management of Highly Hazardous Pesticides, possibly legally binding, and more engagement in alternative techniques that minimise chemical use~~s~~, such as agroecological techniques and integrated pest management.

In late 2020, FAO issued a draft Global Action Plan on HHPs, again acknowledging international concern and proposing a goal of the phase-out of HHPS from agriculture by 2030.

In 2022 UNEP issued a "Summary for Policy Makers" of its report on pesticides and fertilisers for UNEA[11]. Key findings included, that "progress has been made in strengthening management of pesticides and fertilizers, including through international agreements. However, these agreements have not been sufficient to address all adverse environmental and health impacts comprehensively". The report recommends to: "Fundamentally change crop management and adopt ecosystem-based approaches" and lists among as a priority actions to strengthen pesticide management "Minimize or eliminate the risks posed by Highly Hazardous Pesticides".

In September 2023, the fifth International Conference on Chemicals Management (ICCM5) adopted the Global Framework on Chemicals (GFC) as successor to SAICM. Its Bonn Declaration for a Planet Free of Harm from Chemicals[12] recognises that chemical pollution jeopardizes sustainable development and the new framework anchored significant targets

[8] 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

[9] UNEP. Report of the International Conference on Chemicals Management on the work of its fourth session. Geneva: United Nations Environment Programme; 2015. Report No.: SAICM/ICCM.4/15. Available from: http://www.saicm.org/Portals/12/documents/meetings/ICCM4/doc/K1606013_e.pdf

[10] UNEP. 2020. An Assessment Report on Issues of Concern

[11] UNEP (2022): Environmental and health impacts of pesticides and fertilizers and ways of minimizing them . Summary for Policymakers: https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/34463/JSUNEPPF.pdf?sequence=13

[12] The Bonn Declaration for a Planet Free of Harm from Chemicals and Waste https://www.chemicalsframework.org/bonndeclaration

towards the phase-out of Highly Hazardous Pesticides (HHPs) in agriculture[13]. It also agreed on establishing a Global Alliance on HHPs to progress towards the phase-out of HHPs.

In March 2024, the U.N. Environment Assembly (UNEA) supported this engagement by agreeing on a resolution that calls for action to phase-out HHPs globally by 2035[14].

The Present

To implement a progressive ban or phase-out of HHPs as supported by the FAO Council, the COAG, the JMPM, the GFC and others, all stakeholders mentioned in the International Code of Conduct on the Distribution and Use of Pesticides should take action to deliver on this task.. 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 identify 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 engage and to develop plans of action with priorities, timeframes and concrete measures to phase-out HHPs. PAN itself will support such initiatives wherever possible.

Susan Haffmans, PAN Germany, on behalf of the PAN International Regional Centres
PAN Africa
PAN Asia and the Pacific
PAN Europe (PAN Germany and PAN UK)
PAN Latin America
PAN North America

[13] Global Framework on Chemicals – For a Planet free of Harm from Chemicals and Waste. Texts and resolutions of the Fifth International Conference on Chemicals Management. https://www.chemicalsframework.org/page/text-global-framework-chemicals
[14] https://www.brsmeas.org/Portals/4/download.aspx?d=UNEP-EA.6-L.14.English.pdf

About this List

History

The *PAN International List of Highly Hazardous Pesticides* was initially developed to answer the question "What are highly hazardous pesticides?" The first version of this HHP List was published January 16th, 2009. Since then, official classifications of pesticides developed, and the additional PAN criteria for identifying HHPs have been revised several times. Consequently, several updates of the list have been published since. Relevant changes compared to the previous list are explained in the section *'What is new in this list?'*

Purpose

The purpose of this list is to provide stakeholders with a substance list of HHPs. The list is based on the criteria defined by the FAO/WHO JMPM, with additional criteria included by PAN International based solely on classifications by recognised authorities (see Table 1). Explanatory notes regarding the selected hazard criteria is followed by the list of HHPs. The PAN International HHPs 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. It does not include those used as disinfectants, or internal human or veterinary medicines. It includes pesticides mainly used in agriculture, forestry, and gardening (e.g. insecticides, herbicides, fungicides, plant growth regulators and fumigants). Some of the substances are also used in aquaculture or on livestock to control ectoparasites, in homes and buildings, during transport, and in various materials and other products such as paint - to control insects, rodents, algae, and fungi. The list also contains some specific pesticide formulations, which have been recognized by relevant international conventions (see footnotes below the HHP-table at the end of this document). It excludes: synergists, safeners, adjuvants and other additives in formulated pesticide products; and break-down products (metabolites) of pesticide active ingredients.

Basis

The PAN HHP list is currently based only on classifications by internationally recognised authorities. It is created by compiling information from International bodies (WHO), the European (EU Commission), national agencies (USA EPA, Japan), and the Pesticide Property Database.

In future, the HHP List might also include 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 (JMPM HHPs criterion 8), 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.
- 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 currently not considering.
- Pesticides classified as obsolete pesticides by FAO and WHO are not included in the list. However, we know that limited uses still happen illegally, especially if obsolete stockpiles remain and that those pesticides cause harm still today.

What is new in this List

This December 2024 version serves as an update of the 2021 PAN List of HHPs. It is triggered by new evaluations executed by the named authorities. No additions or changes regarding the set of criteria have been made.

Compared to the previous version of the HHP list from March 2021 the following changes occurred:

The following pesticides are no longer on the list:

1. 1,3-dichloropropene, as EPA cancer rating changed
2. Flumioxazin, as EU CLP (GHS) rating of reprotoxicity changed to "repr 2"
3. Permethrin, as EPA cancer rating changed
4. Tioxazafen, as EPA cancer rating changed

The following pesticides have been added to the list:

1. Acibenzolar-S-methyl, GHS EU Repr 1B
2. Broflanilide, US EPA probable carcinogen
3. Bromoxynil butyrate, H330. GHS EU
4. Bromoxynil-potassium, JP GHS H330
5. Calcium phosphide, JP GHS H330
6. Chlorine dioxide, JP GHS H330
7. Cymoxanil, Repr. JP GHS 1B.
8. Dimethomorph, Repr 1B EU
9. Ergocalciferol, JP GHS H330
10. Formetanate hydrochloride, JP GHS H330
11. Guazatine, JP GHS H330
12. Ipconazole, Repr 1B EU
13. Isazofos, JP GHS H330
14. Isoflucypram, PPDB vT & vP
15. Thiram as active substance, JP GHS Muta 1B, H330
16. Asulam, EU EDC
17. Triflusulfuron-methyl, EU EDC
18. Metribuzin, EU EDC
19. Buprofezin, EU EDC
20. Fludioxonil, EU EDC
21. Cyprodinil, EU EDC
22. Flufenacet, EU EDC
23. Fenoxaprop-P, EU EDC
24. Ethiprole, EU EDC
25. Proquinazid, EU EDC

Work in progress

The FAO definition of an 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***. Suitable

criteria for indicating intentional and occupational or accidental poisoning are the Poisoning Severity Score (PSS)[15] and the case fatality rate (CFR).[16]

PAN International has not yet developed an agreed position on threshold values for what levels or scales of poisoning incidents qualify as HHPs.

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 major 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 important aspect of natural pest control is not yet available.

PAN International plans to work on these issues and invites scientists who are interested in supporting the development of key characteristics contributing to such criteria, to share their suggestions and expert advice.

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:
susan.haffmans@pan-germany.org

Table 1. PAN International Indicators for Identifying 'Highly Hazardous Pesticides'

Table 1 shows the criteria and sources used by PAN to identify pesticides considered to be highly hazardous according to PAN. PAN has used recognised authorities for these criteria and sources, as described below.

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 EU or the Japan Globally Harmonized System (GHS) or
Long term toxic effects

[15] https://cdn.who.int/media/docs/default-source/chemical-safety/intox/pss95699a36-61ab-4be6-848f-c1d894d21fbd.pdf?sfvrsn=5750967e_10
[16] https://pmc.ncbi.nlm.nih.gov/articles/PMC8394312/

Carcinogenic to humans according to IARC or US EPA or
'Known or presumed human carcinogens' (Category I) according to the EU or the Japan Globally Harmonized System (GHS) or
Probable/likely carcinogenic to humans according to IARC, US EPA or
Likely to be Carcinogenic to Humans: At High Doses according to 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 EU or the Japan Globally Harmonized System (GHS) or
'Known or Presumed human reproductive toxicant' (Category I) according to the EU or the Japan Globally Harmonized System (GHS) or
Endocrine disruptor
EU interim criteria as laid down in Reg. (EC) No 1107/2009 'Suspected human reproductive toxicant' (Category 2) *AND* 'Suspected human carcinogen' (Category 2) according to the EU or the Japan Globally Harmonized System (GHS) or
Pesticides identified as endocrine disrupters in the EU: ED criteria met according to points 3.6.5 and/or 3.8.2 of Annex II of Regulation (EC) 1107/2009 as amended by Commission Regulation (EU) 2018/605[17]
High environmental concern
Pesticides listed in Annex A & B of the Stockholm Convention or meeting the Conventions' criteria or Ozone depleting pesticides 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 or meeting the Conventions' criteria

[17] EFSA - Overview of the endocrine disrupting (ED) assessment of pesticide active substances in line with the criteria introduced by Commission Regulation 2018/605: https://www.efsa.europa.eu/sites/default/files/2023-12/overview-endocrine-disrupting-assessment-pesticide-active-substances.xlsx (accessed 11.10.24)

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. It has been adopted by a large number of countries as the main chemical hazard communication system, but it has not yet been fully implemented on a global scale. In this list, PAN refers to the "EU GHS List", laid down in EU Regulation 1272/2008/EC on classification, labelling and packaging of substances and mixtures (so called "CLP-Regulation") which entered into force in January 2009 and which implements the GHS in the Europe Union. A pesticide with its specific classification[18] is also added to the HHP list, in case the pesticide was excluded from EU authorization because it qualifies as Carc 1, Muta 1 or Repr 1, but is not yet listed as such in EU Regulation 1272/2008/EC. This is in line with the approval criteria ("exclusion criteria") laid down in the EU Pesticide Regulation 1107/2009 Annex II. The reason for this is: The EU Regulation 1272/2008/EC considerably lacks behind other EU legislation. It can take several years that a confirmed classification officially enters the relevant EU GHS regulation, while decision documents (regulation) of non-approved pesticides already refer to the new classification.

With the 2021 update, PAN included the GHS Japan list as an additional source for the identification of HHPs. Both GHS lists– the one from the EU and the one from Japan - are used 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. Current version at https://eur-lex.europa.eu/eli/reg/2008/1272/2023-12-01.

GHS classification by the Japanese Government (2020): https://www.chem-info.nite.go.jp/chem/english/ghs/r5_list_e.html

The WHO Recommended Classification of Pesticides by Hazard

The latest revision of the WHO Recommended Classification of Pesticides by Hazards was conducted in 2019. The PAN HHP list includes those pesticides listed in WHO Class Ia and Ib.

The 2019 WHO classification must be considered incomplete for the following reasons:

[18] In case the pesticide is already on the HHP list

- 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[19]). 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).
- 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[20] are neglected in this calculation although they may have an influence on the toxicity of the formulation or the mixture.

Source used:

WHO (2019): WHO recommended classification of pesticides by hazard and guidelines to classification, 2019 edition. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0IGO.

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.

Pesticides which are classified as 'carcinogenic to humans' or 'probably carcinogenic to humans' according to IARC have been included in this revised version of the PAN List of HHPs.

Source used:

IARC (2018): Agents reviews by the IARC Monographs, Volumes 1-123 (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[21], based on pesticides registered in the U.S.A. The list is updated annually; it is a product of the general risk assessment included in the process of pesticide

[19] Dawson AH, et al. (2010): Acute Human Lethal Toxicity of Agricultural Pesticides: A Prospective Cohort Study. PLoS Medicine 7(10): e1000357

[20] "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.

[21] US EPA (up to 2018): 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

registration. This classification includes the potential exposure of humans[22]. 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. With the 2021 update, PAN agreed on adding those pesticides to the HHP list that are likely to be carcinogenic to humans "at high doses" according to EPA.

Source used:

US EPA (up to 2018): Annual Cancer Report. 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[23]. 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 HHPs.

EU categorisation of endocrine disruptors

The issue of endocrine disrupting (ED) pesticides gained widespread public, political and scientific attention at the beginning of the 1990s. However, the process of agreeing on criteria for their identification has been very slow. With Regulation 1107/2009/EC the European Union decided to exclude from EU authorization pesticide active ingredients with endocrine disrupting properties that may cause adverse effects in humans or non-target organisms. In 2018, the EU adopted a set of criteria laid down in the Reg. 2018/605[24] and technical guidelines to identify endocrine disruptive pesticides. This identification is now done step by step within the process of EU pesticide approval and re-approval. In 2020, the first pesticide that was officially identified by the EU as an ED pesticide was mancozeb, with more pesticides identified by the EU as ED pesticides in the following years. It will take years for the EU to identify more ED pesticides according to the agreed criteria.

As the EU evaluates pesticides for effects on the endocrine system only in the process of EU approval, the number of pesticides evaluated is very limited. A global assessment of all pesticides is needed, to overcome this deficit.

In April 2023, the EU laid down new criteria for identifying ED properties of substances as well as persistent and mobile chemicals for cross-sectoral use as part of the CLP Regulation. This new hazard classifications will become binding in the EU in November 2026: https://echa.europa.eu/new-hazard-classes-2023.

Until there is a comprehensive list of pesticides assessed accordingly, the PAN HHP List will continue to use in addition to the EU ED criterion the interim criteria for EDCs as laid down in the Pesticide Regulation 1107/2009/EC. These includes pesticides, which meet the GHS

[22] 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

[23] US EPA (2019): 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

[24] Commission Regulation (EU) 2018/605 of 19 April 2018 amending Annex II to Regulation (EC) No 1107/2009 by setting out scientific criteria for the determination of endocrine disrupting properties https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R0605

classifications of carcinogenic category 2 *AND* are at the same time toxic for reproduction category 2. For identifying those, PAN uses the Japan and EU GHS classifications. Knowing that this approach is not ideal, we will follow approaches to identify ED pesticides from other regions and agencies and consider integrating them in this List in the future.

Sources used:

EC (2008-2020): 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

EC (2018): Regulation 2018/605 of 19 April 2018 amending Annex II to Regulation (EC) No 1107/2009 by setting out scientific criteria for the determination of endocrine disrupting properties

EFSA (2024): Overview of the endocrine disrupting (ED) assessment of pesticide active substances in line with the criteria introduced by Commission Regulation 2018/605: https://www.efsa.europa.eu/sites/default/files/2023-12/overview-endocrine-disrupting-assessment-pesticide-active-substances.xlsx

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 as agreed by the Convention's Review Committee (POPRC) and by the Conference of the Parties (CoP) (but which are not yet not formally listed) are on the PAN list of HHP.

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 or agreed by the Convention's Chemical Review Committee (CRC) and by the Conference of the Parties (CoP) as meeting the criteria of the Convention (but yet not listed for political or trade reasons which are not consistent with the text or intent of the Convention) are on the PAN list of HHPs.

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 HHPs.

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.[25] 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 (2018): 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[26] 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 (2020): 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

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

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

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).

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 the 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).The 2021 version included the following: the updated 2019 WHO recommendation for Classification of Pesticides by Hazards; changes in identifying obsolete pesticides; PAN's decision to include Japan's GHS classification; changes to the criteria for identifying endocrine disruptors; and inclusion of a U.S. EPA classification for pesticides that are 'likely to be carcinogenic to humans at high doses' under the ~~expansion~~ criteria for carcinogenic pesticides. No changes to the included classifications have happened since the last update in 2021.

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 3 Grouped Pesticides)*

Since December 2016

Carbetamide
Cyanamide
Chlorophene; 2-benzyl-4-chlorophenol
Dicofol
Emamectin benzoate
Fenpyroximate
Quinolin-8-ol; 8-hydroxyquinoline
Sulfluramide
Triadimenol

Since March 2018

Calcium cyanide
Cyproconazole
Flupyradifurone
Group: Glyphosate and its salts (see group table)
Noviflumuron
Propiconazole
Propineb
Sodium cyanide
Tioxafen
Hydrogen cyanide

Since March 2019

2,4-D
Acifluorfen, sodium
Biphenyl, Diphenyl
Bromophos-ethyl
Captan
Chlorpropham
Cholecalciferol
Cyanazine
Demeton-methyl
Dichlobenil
Dichlorprop
Diphenyl/biphenyl
Dodine
Ethion
Fenbuconazole
Fenhexamid
Ferbam
Fluazinam
Flusulfamide
Fluvalinate
Forchlorfenuron
Furfural
Halosulfuron-methyl
Imazalil sulfate
Lactofen
Mecoprop, MCPP
Meptyldinocap
Pyrethrins, Pyrethrum extract
Pyrimidifen
Simazine
Tau-fluvalinate
Tebuconazole
Thiabendazole
Tribufos, Tribuphos
Trichloracetic acid

Since March 2021

Acibenzolar-S-methyl
Broflanilide
Bromoxynil butyrate
Bromoxynil-potassium
Buprofezin
Calcium phosphide
Chlorine dioxide
Cymoxanil
Cyprodinil
Dimethomorph
Ergocalciferol
Ethiprol
Fenoxaprop-P
Fludioxonil
Flufenacet
Formetanate hydrochloride
Guazatine
Ipconazole
Isazofos
Isoflucypram
Metribuzin
Proquinazid
Thiram (as active substance)
Triflusulfuron-methyl

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

Since December 2016

MGK 326

Since March 2018

Cyflufenamid
Sedaxane
Nitrapyrin
Sodium dimethyl dithio carbamate
Propyzamide

Since March 2019

2,4-DB
Atrazine
Hydrogen cyanamide
Fenarimol
Ioxynil
Picloram
Terbutryn
Zineb

Since March 2021

1,3-dichloropropene
Flumioxazin
Permethrin
Tioxazafen

Table 2. Legend for the PAN HHP List / 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 EU or Japan Globally Harmonised System (GHS)
max = 1	This active ingredient meets at least one criterion in this Group
EPA carc	Human carcinogen according to EPA
IARC carc	Human carcinogen according to IARC
GHS^{+} carc (1A, 1B)	Known or presumed human carcinogens (1A or 1B) according to EU or Japan GHS
EPA prob/likel carc	Probable/ Likely carcinogen (including "Likely to be Carcinogenic to Humans: At High Doses" according to EPA
IARC prob carc	Probable carcinogen according to IARC
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 or Japan GHS.
GHS^{+} repro (1A, 1B)	Known or presumed human reproductive toxicant according to EU or Japan GHS.
GHS^{+} C2 & R2	Pesticides classified GHS Carcinogen Category 2 AND Reproductive Category 2 following EU or Japan GHS
EU ED	. ED criteria met according to points 3.6.5 and/or 3.8.2 of Annex II of Regulation (EC) 1107/2009 as amended by Commission Regulation (EU) 2018/605
Very bio acc	Very bioaccumulative (BCF >5000) or Kow logP >5 (BCF values supersede Kow logP data)
Very pers 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 or meeting the criteria for being listed
POP	Listed in Annex III of the Stockholm Convention or meeting the criteria for being listed

Table 3. Grouped Pesticides in the HHPs List

Some pesticides are grouped in the list as follows:

Group/ pesticides	CAS Number
Arsenic and its coumpounds	
Arsenic pentoxide	1303-28-2
Arsenic pentoxide hydrate	12044-50-7
Arsenic trioxide	1327-53-3
Cacolydate; sodium dimethylarsinate	124-65-2
Calcium arsenate	7778-44-1
Chromated copper arsenate; CCA	75-60-5
Copper arsenate	7778-41-8
DSMA; Disodium methanearsonate	144-21-8
Lead arsenate	7784-40-9
MAA, methylarsonic acid	124-58-3
MSMA	2163-80-6
MSMA, calcium salt	5902-95-4
Paris Green	12002-03-8
Sodium arsenate	13464-38-5
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
Glyphosate and its salts	
Glyphosate (acid)	1071-83-6
Glyphosate-diammonium	69254-40-6
Glyphosate-isopropylamine (-isopropylammonium;-IPA)	38641-94-0
Glyphosate-monoammonium	40465-66-5
Glyphosate-sodium	34494-03-6
Glyphosate-trimesium	81591-81-3
Mercury and its compounds	
2-Acetoxymercuricethanol phenylmercuric lactate	4665-55-8

Chloromethoxypropylmercuric acetate; CPMA	1319-86-4
Cyanomethylmercuricguanidine	502-39-6
Diphenylmercurydodecenylsuccinate; PMDS	27236-65-3
Hydroxymercuri-o-nitrophenol	17140-73-7
Mercuric acetate	1600-27-7
Mercuric chloride	7487-94-7
Mercuric oxide	21908-53-2
Mercurous chloride	7546-30-7
Mercury	7439-97-6
Mercury naphthenate	1336-96-5
Mercury oleate	1191-80-6
Mercury pentanedione	14024-55-6
Mercury phenate	589-66-9
Methoxyethylmercuric acetate	151-38-2
Methoxyethylmercuric chloride	123-88-6
Methylmercury 2,3 dihydoxypropyl mercaptide	2597-95-7
Methylmercury 8-quinolinolate	86-85-1
Methylmercury acetate	108-07-6
Methylmercury benzoate	3626-13-9
Methylmercury hydroxide	1184-57-2
Methylmercury nitrite	2591-97-9
Methylmercury propionate	5903-10-6
N-Phenylmercuric urea	2279-64-3
Phenylethylmercuric salicylate	54-64-8
Phenylmercuric ammonium acetate	53404-67-4
Phenylmercuric ammonium propionate	53404-68-5
Phenylmercuric borate	102-98-7
Phenylmercuric carbonate	53404-69-6
Phenylmercuric chloride	100-56-1
Phenylmercuric dimethyldithiocarbamate	32407-99-1
Phenylmercuric formamide	22894-47-9
Phenylmercuric hydroxide	100-57-2
Phenylmercuric lactate	122-64-5
Phenylmercuric laurylmercaptide	unknown
Phenylmercuric monoethanol ammonium acetate	5822-97-9
Phenylmercuric monoethanol ammonium lactate	53404-70-9
Phenylmercuric napthenate	31632-68-5
Phenylmercuric nitrate	55-68-5
Phenylmercuric oleate; PMO	104-68-9
Phenylmercuric propionate	103-27-5
Phenylmercuric salicylate	28086-13-7

Phenylmercuric thiocyanate	16751-55-6
Phenylmercuric threthanolammonium lactate	23319-66-6
phenylmercuric-2-ethylhexonate	13302-00-6
phenylmercuric-8-quinolinate	26114-17-0
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

PAN International List of Highly Hazardous Pesticides / table of active ingredients - December 2024

					Group 1: Acute Toxicity				Group 2: Long term effects										Group 3: Environmental toxicity					Group 4: Conventions				
	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS+ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS+ muta (1A, 1B)	GHS+ repro (1A ,1B)	EU EDC	GHS+ C2 & R2	**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					**30**	**52**	**74**	**129**	**1**	**4**	**21**	**7**	**75**	**6**	**56**	**17**	**56**	**173**	**22**	**19**	**31**	**117**	**150**	**1**	**33**	**0**	**9**	**38**
1	94-75-7	2,4-D		**1**				**0**									1	**1**					**0**					**0**
2	71751-41-2	Abamectin		**2**		1	1	**1**										**0**				1	**1**					**0**
3	30560-19-1	Acephate		**2**				**0**							1			**1**				1	**1**					**0**
4	34256-82-1	Acetochlor		**1**				**0**			1						1	**1**					**0**					**0**
5	135158-54-2	Acibenzolar-S-methyl		**1**				**0**							1			**1**					**0**					**0**
6	62476-59-9	Acifluorfen, sodium		**1**				**0**					*1*					**1**					**0**					**0**
7	101007-06-1	Acrinathrin		**1**				**0**										**0**				1	**1**					**0**
8	107-02-8	Acrolein		**2**		1	1	**1**							1			**1**					**0**					**0**
9	15972-60-8	Alachlor		**2**				**0**					*1*				1	**1**					**0**		1			**1**
10	83130-01-2	Alanycarb		**1**				**0**										**0**				1	**1**					**0**
11	116-06-3	Aldicarb		**3**	1		1	**1**										**0**				1	**1**		1			**1**
12	319-84-6	alpha-BHC; alpha-HCH		**1**				**0**										**0**					**0**				1	**1**
13	96-24-2	Alpha-chlorohydrin		**1**		1		**1**										**0**					**0**					**0**
14	20859-73-8	Aluminum phosphide		**2**			1	**1**										**0**				1	**1**					**0**
15	348635-87-0	Amisulbrom		**1**				**0**										**0**		1	1		**1**					**0**
16	61-82-5	Amitrole		**1**				**0**							1			**1**					**0**					**0**

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	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS+ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS+ muta (1A, 1B)	GHS+ repro (1A,1B)	EU EDC	GHS+ C2 & R2	**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**
17	90640-80-5	Anthracene oil		1				0			1							1					0					0
18	84-65-1	Anthraquinone		1				0			1		1					1					0					0
19		Arsen and its compounds	x	1				0	1	1	1							1					0					0
20	3337-71-1	Asulam		1				0								1		1					0					0
21	68049-83-2	Azafenidin		1				0							1			1					0					0
22	35575-96-3	Azamethiphos		1				0										0				1	1					0
23	2642-71-9	Azinphos-ethyl		2		1		1										0				1	1					0
24	86-50-0	Azinphos-methyl		3		1	1	1										0				1	1		1			1
25	41083-11-8	Azocyclotin		2			1	1										0	1		1		1					0
26	22781-23-3	Bendiocarb		1				0										0				1	1					0
27	82560-54-1	Benfuracarb		1				0										0				1	1					0
28	17804-35-2	Benomyl		2				0						1	1			1					0		1	X		1
29	741-58-2	Bensulide		1				0										0				1	1					0
30	177406-68-7	Benthiavalicarb-isopropyl		1				0			1		1			1		1					0					0
31	1820573-27-0	Beta-cyfluthrin		2		1	1	1										0				1	1					0
32	319-85-7	beta-HCH; beta-BCH		2				0									1	1					0				1	1

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33	82657-04-3	Bifenthrin		2				0									1	1				1	1					0
34	28434-01-7	Bioresmethrin		2				0							1			1				1	1					0
35	92-52-4	Biphenyl; Diphenyl		1				0			1							1					0					0
36	2079-00-7	Blasticidin-S		1		1		1										0					0					0
37		Borax; Borate salts	x	1				0							1			1					0					0
38	10043-35-3	Boric acid		1				0							1		1	1					0					0
39	56073-10-0	Brodifacoum		2	1		1	1							1			1					0					0
40	1207727-04-5	Broflanilide		1				0					1					1					0					0
41	28772-56-7	Bromadiolone		2	1		1	1							1			1					0					0
42	63333-35-7	Bromethalin		2	1			1										0	1		1		1					0
43	4824-78-6	Bromophos-ethyl		1		1		1										0					0					0
44	1689-84-5	Bromoxynil		2			1	1							1			1					0					0
45	3861-41-4	Bromoxynil butyrate		1			1	1										0					0					0
46	56634-95-8	Bromoxynil heptanoate		2				0							1			1	1		1		1					0
47	1689-99-2	Bromoxynil octanoate		2				0							1			1	1		1		1					0
48	2961-68-4	Bromoxynil-potassium		1			1	1										0					0					0
49	69327-76-0	Buprofezin		1				0								1		1					0					0

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50	23184-66-9	Butachlor		**1**				**0**					1					**1**					**0**					**0**
51	34681-10-2	Butocarboxim		**2**		1		**1**										**0**				1	**1**					**0**
52	34681-23-7	Butoxycarboxim		**1**		1		**1**										**0**					**0**					**0**
53	95465-99-9	Cadusafos		**2**		1	1	**1**										**0**		1	1	1	**1**					**0**
54	592-01-8	Calcium cyanide		**1**	1			**1**										**0**					**0**					**0**
55	1305-99-3	Calcium phosphide		**1**			1	**1**										**0**					**0**					**0**
56	2425-06-1	Captafol		**3**	1			**1**			1	1	1					**1**					**0**		1			**1**
57	133-06-2	Captan		**1**				**0**					*1*				1	**1**					**0**					**0**
58	63-25-2	Carbaryl		**2**				**0**					1				1	**1**				1	**1**					**0**
59	10605-21-7	Carbendazim		**1**				**0**						1	1			**1**					**0**					**0**
60	16118-49-3	Carbetamide		**1**				**0**							1			**1**					**0**					**0**
61	1563-66-2	Carbofuran		**3**		1	1	**1**										**0**				1	**1**		1	X		**1**
62	55285-14-8	Carbosulfan		**3**			1	**1**										**0**				1	**1**		1	C_{PIC}		**1**
63	2439-01-2	Chinomethionat; Oxythioquinox		**1**				**0**					1					**1**					**0**					**0**
64	500008-45-7	Chlorantraniliprole		**1**				**0**										**0**		1	1		**1**					**0**
65	57-74-9	Chlordane		**3**				**0**					1				1	**1**	1				**1**		1		1	**1**
66	54593-83-8	Chlorethoxyphos		**2**	1			**1**										**0**				1	**1**					**0**

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	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS+ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS+ muta (1A, 1B)	GHS+ repro (1A ,1B)	EU EDC	GHS+ C2 & R2	**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**
67	122453-73-0	Chlorfenapyr		1				0										0				1	1					0
68	470-90-6	Chlorfenvinphos		2		1		1										0				1	1					0
69	71422-67-8	Chlorfluazuron		1				0										0	1		1		1					0
70	10049-04-4	Chlorine dioxide		1			1	1										0					0					0
71	24934-91-6	Chlormephos		1	1			1										0					0					0
72	67-66-3	Chloroform		1				0					1					1					0					0
73	3691-35-8	Chlorophacinone		1	1			1										0					0					0
74	120-32-1	Chlorophene; 2-benzyl-4-chlorophenol		1				0									1	1					0					0
75	76-06-2	Chloropicrin		1			1	1										0					0					0
76	1897-45-6	Chlorothalonil		2			1	1					1					1					0					0
77	15545-48-9	Chlorotoluron		1				0									1	1					0					0
78	101-21-3	Chlorpropham		1				0									1	1					0					0
79	2921-88-2	Chlorpyrifos		2				0							1			1				1	1					0
80	5598-13-0	Chlorpyrifos-methyl		2				0							1			1				1	1					0
81	67-97-0	Cholecalciferol		1				0							1			1					0					0
82	38083-17-9	Climbazole		1				0										0				1	1					0
83	210880-92-5	Clothianidin		1				0										0				1	1					0

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84	20427-59-2	Copper (II) hydroxide		2			1	1										0		1	1		1					0
85	56-72-4	Coumaphos		2		1	1	1							1			1					0					0
86	5836-29-3	Coumatetralyl		1		1	1	1							1			0					0					0
87	8001-58-9	Creosote		1				0			1	1	1					1					0					0
88	420-04-2	Cyanamide		1				0									1	1					0					0
89	21725-46-2	Cyanazine		1				0									1	1					0					0
90	68359-37-5	Cyfluthrin		2		1	1	1										0				1	1					0
91	68085-85-8	Cyhalothrin		1				0										0				1	1					0
92	76703-62-3	Cyhalothrin, gamma		1				0										0				1	1					0
93	13121-70-5	Cyhexatin		1				0										0	1		1		1					0
94	57966-95-7	Cymoxanil		1				0							1			1					0					0
95	52315-07-8	Cypermethrin		1				0										0				1	1					0
96	67375-30-8	Cypermethrin, alpha		1				0										0				1	1					0
97	52315-07-8b	Cypermethrin, beta		1				0										0				1	1					0
98	94361-06-5	Cyproconazole		1				0							1			1					0					0
99	121552-61-2	Cyprodinil		1				0								1		1					0					0
100	1596-84-5	Daminozide		1				0					1					1					0					0

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101	50-29-3	DDT		3				0				1	1				1	1		1	1		1		1		1	1
102	52918-63-5	Deltamethrin		2				0									1	1				1	1					0
103	8022-00-2	Demeton-methyl (isomere mix of O-methyl and S-methyl)		1			1	1										0					0					0
104	919-86-8	Demeton-S-methyl		2		1		1										0				1	1					0
105	80060-09-9	Diafenthiuron		1				0										0				1	1					0
106	333-41-5	Diazinon		2				0			1				1			1				1	1					0
107	1194-65-6	Dichlobenil		1				0									1	1					0					0
108	120-36-5	Dichlorprop		1				0							1			1					0					0
109	62-73-7	Dichlorvos; DDVP		3		1	1	1							1			1				1	1					0
110	51338-27-3	Diclofop-methyl		1				0					1					1					0					0
111	115-32-2	Dicofol		2				0									1	1					0			C_{POP}	1	1
112	141-66-2	Dicrotophos		2		1		1										0				1	1					0
113	56073-07-5	Difenacoum		2	1			1										0	1				1					0
114	104653-34-1	Difethialone		2	1		1	1							1			1					0					0
115	60-51-5	Dimethoate		2				0							1			1				1	1					0
116	110488-70-5	Dimethomorph		1				0							1	1		1					0					0

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117	149961-52-4	Dimoxystrobin		2				0									1	1		1	1		1					0
118	39300-45-3	Dinocap		1				0							1			1					0					0
119	165252-70-0	Dinotefuran		1				0										0				1	1					0
120	1420-07-1	Dinoterb		2		1		1							1			1					0					0
121	82-66-6	Diphacinone		1	1			1										0					0					0
122	85-00-7	Diquat dibromide		1			1	1										0					0					0
123	4032-26-2	Diquat dichloride		1			1	1										0					0					0
124	298-04-4	Disulfoton		1	1			1										0					0					0
125	330-54-1	Diuron		1				0			1		1					1					0					0
126		DNOC and its salts	x	2		1	1	1										0					0		1			1
127	2439-10-3	Dodine		1			1	1										0					0					0
128	297-99-4	E-Phosphamidon		1	1			1										0					0					0
129	17109-49-8	Edifenphos		1		1		1										0					0					0
130	155569-91-8	Emamectin benzoate		1				0										0		1	1	1	1					0
131	115-29-7	Endosulfan		2			1	1										0					0		1		1	1
132	106-89-8	Epichlorohydrin		1				0			1	1	1				1	1					0					0
133	2104-64-5	EPN		2	1			1										0				1	1					0

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134	133855-98-8	Epoxiconazole		**1**				**0**					1		1		1	**1**					**0**					**0**
135	50-14-6	Ergocalciferol		**1**			1	**1**										**0**					**0**					**0**
136	66230-04-4	Esfenvalerate		**2**			1	**1**										**0**				1	**1**					**0**
137	29973-13-5	Ethiofencarb		**1**		1		**1**										**0**					**0**					**0**
138	563-12-2	Ethion		**1**			1	**1**										**0**					**0**					**0**
139	181587-01-9	Ethiprole		**1**				**0**								1		**1**					**0**					**0**
140	23947-60-6	Ethirimol		**1**				**0**										**0**				1	**1**					**0**
141	13194-48-4	Ethoprophos; Ethoprop		**2**	1		1	**1**					1		1			**1**					**0**					**0**
142	106-93-4	Ethylene dibromide; 1,2-dibromoethane		**2**				**0**			1	1	1				1	**1**					**0**		1			**1**
143	107-06-2	Ethylene dichloride; 1,2-Dichloroethane		**2**				**0**			1		1					**1**					**0**		1			**1**
144	75-21-8	Ethylene oxide		**2**				**0**		1	1			1	1			**1**					**0**		1			**1**
145	96-45-7	Ethylene thiourea		**1**				**0**					1		1		1	**1**					**0**					**0**
146	80844-07-1	Etofenprox; Ethofenprox		**1**				**0**										**0**		1	1	1	**1**					**0**
147	52-85-7	Famphur		**1**		1		**1**										**0**					**0**					**0**
148	22224-92-6	Fenamiphos		**2**		1	1	**1**										**0**				1	**1**					**0**
149	120928-09-8	Fenazaquin		**1**				**0**										**0**				1	**1**					**0**

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	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS⁺ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS⁺ muta (1A, 1B)	GHS⁺ repro (1A ,1B)	EU EDC	GHS⁺ C2 & R2	**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**
150	114369-43-6	Fenbuconazole		**1**				**0**									1	**1**					**0**					**0**
151	13356-08-6	Fenbutatin-oxide		**2**			1	**1**										**0**		1	1		**1**					**0**
152	103112-35-2	Fenchlorazole-ethyl		**1**				**0**			1							**1**					**0**					**0**
153	126833-17-8	Fenhexamid		**1**			1	**1**										**0**					**0**					**0**
154	122-14-5	Fenitrothion		**2**				**0**									1	**1**				1	**1**					**0**
155	113158-40-0	Fenoxaprop-P		**1**				**0**								1		**1**					**0**					**0**
156	72490-01-8	Fenoxycarb		**2**				**0**					1					**1**				1	**1**					**0**
157	39515-41-8	Fenpropathrin		**2**			1	**1**										**0**				1	**1**					**0**
158	134098-61-6	Fenpyroximate		**1**			1	**1**										**0**					**0**					**0**
159	55-38-9	Fenthion / Fenthion > 640g/L		**2**				**0**										**0**				1	**1**		1	CE		**1**
160	900-95-8	Fentin acetate; Triphenyltin acetate		**2**			1	**1**									1	**1**					**0**					**0**
161	900-95-8	Fentin hydroxide; Triphenyltin hydroxide		**2**			1	**1**					1				1	**1**					**0**					**0**
162	51630-58-1	Fenvalerate		**1**				**0**										**0**				1	**1**					**0**
163	14484-64-1	Ferbam		**1**			1	**1**										**0**					**0**					**0**
164	120068-37-3	Fipronil		**1**				**0**										**0**				1	**1**					**0**
165	90035-08-8	Flocoumafen		**2**	1		1	**1**							1			**1**					**0**					**0**

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166	69806-50-4	Fluazifop-butyl		1				0							1			1					0					0
167	79622-59-6	Fluazinam		2			1	1							1			1					0					0
168	174514-07-9	Fluazolate		1				0										0	1		1		1					0
169	272451-65-7	Flubendiamide		1				0										0		1	1		1					0
170	70124-77-5	Flucythrinate		2		1		1										0				1	1					0
171	131341-86-1	Fludioxonil		1				0								1		1					0					0
172	142459-58-3	Flufenacet		1				0								1		1					0					0
173	101463-69-8	Flufenoxuron		1				0										0	1		1		1					0
174	62924-70-3	Flumetralin		1				0										0	1		1		1					0
175	640-19-7	Fluoroacetamide		2		1		1										0					0		1			1
176	951659-40-8	Flupyradifurone		1				0										0				1	1					0
177	85509-19-9	Flusilazole		1				0							1			1					0					0
178	106917-52-6	Flusulfamide		1			1	1										0					0					0
179	117337-19-6	Fluthiacet-methyl		1				0					1					1					0					0
180	69409-94-5	Fluvalinate		1			1	1										0					0					0
181	133-07-3	Folpet		2			1	1									1	1					0					0

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182	68157-60-8	Forchlorfenuron		**1**				**0**									1	**1**					**0**					**0**
183	50-00-0	Formaldehyde		**1**				**0**		1			1					**1**					**0**					**0**
184	22259-30-9	Formetanate		**2**		1	1	**1**										**0**				1	**1**					**0**
185	23422-53-9	Formetanate hydrochloride		**1**			1	**1**										**0**					**0**					**0**
186	98886-44-3	Fosthiazate		**1**				**0**										**0**				1	**1**					**0**
187	65907-30-4	Furathiocarb		**1**		1	1	**1**										**0**					**0**					**0**
188	98-01-1	Furfural		**1**				**0**					*1*					**1**					**0**					**0**
189	121776-33-8	Furilazole		**1**				**0**					1					**1**					**0**					**0**
190	77182-82-2	Glufosinate-ammonium		**1**				**0**							1			**1**					**0**					**0**
191	1071-83-6	Glyphosate		**1**				**0**				1						**1**					**0**					**0**
192	108173-90-6	Guazatine		**1**			1	**1**										**0**					**0**					**0**
193	111872-58-3	Halfenprox		**1**				**0**										**0**	1		1		**1**					**0**
194	100784-20-1	Halosulfuron-methyl		**1**				**0**						1				**1**					**0**					**0**
195	69806-40-2	Haloxyfop-methyl (unstated stereochemistry)		**1**				**0**					1					**1**					**0**					**0**
196	23560-59-0	Heptenophos		**2**		1		**1**										**0**				1	**1**					**0**

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197	118-74-1	hexachlorobenzene / benzene hexachloride (HCB/BHC)		**4**	1			**1**			1		1				1	**1**	1				**1**		1		1	**1**
198	86479-06-3	Hexaflumuron		**1**				**0**										**0**				1	**1**					**0**
199		Hexchlorocyclohexane; mix of isomers (beta-HCH & alpha-HCH)		**2**				**0**					1				1	**1**					**0**		1			**1**
200	78587-05-0	Hexythiazox		**1**				**0**					1					**1**					**0**					**0**
201	74-90-8	Hydrogen cyanide**		**1**	1		1	**1**										**0**										**0**
202	35554-44-0	Imazalil		**1**				**0**					1					**1**					**0**					**0**
203	58594-72-2	Imazalil sulfate		**1**				**0**					1					**1**					**0**					**0**
204	138261-41-3	Imidacloprid		**1**				**0**										**0**				1	**1**					**0**
205	72963-72-5	Imiprothrin		**1**				**0**										**0**				1	**1**					**0**
206	173584-44-6	Indoxacarb		**1**				**0**										**0**				1	**1**					**0**
207	125225-28-7	Ipconazole		**1**				**0**							1			**1**					**0**					**0**
208	36734-19-7	Iprodione		**2**				**0**					1					**1**					**0**		1			**1**
209	140923-17-7	Iprovalicarb		**1**				**0**					1					**1**					**0**					**0**
210	42509-80-8	Isazofos		**1**			1	**1**										**0**					**0**					**0**
211	1255734-28-1	Isoflucypram		**1**				**0**										**0**		1	1		**1**					**0**

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212	881685-58-1	Isopyrazam		**2**				**0**					1					**1**		1	1		**1**					**0**
213	141112-29-0	Isoxaflutole		**1**				**0**					1					**1**					**0**					**0**
214	18854-01-8	Isoxathion		**2**		1		**1**										**0**				1	**1**					**0**
215	143390-89-0	Kresoxim-methyl		**1**				**0**					1					**1**					**0**					**0**
216	77501-63-4	Lactofen		**1**				**0**					*1*					**1**					**0**					**0**
217	91465-08-6	Lambda-cyhalothrin		**2**			1	**1**										**0**				1	**1**					**0**
218	58-89-9	Lindane		**3**				**0**		1							1	**1**				1	**1**		1		1	**1**
219	330-55-2	Linuron		**1**				**0**							1		1	**1**					**0**					**0**
220	103055-07-8	Lufenuron		**1**				**0**										**0**	1	1	1		**1**					**0**
221	12057-74-8	Magnesium phosphide		**1**			1	**1**										**0**					**0**					**0**
222	121-75-5	Malathion		**2**				**0**			1	1						**1**				1	**1**					**0**
223	8018-01-7	Mancozeb		**1**				**0**					1		1	1		**1**					**0**					**0**
224	12427-38-2	Maneb		**1**				**0**					1				1	**1**					**0**					**0**
225	2595-54-2	Mecarbam		**1**		1		**1**										**0**					**0**					**0**
226	7085-19-0	Mecoprop; MCPP		**0**				**0**										**0**					**0**					**0**
227	110235-47-7	Mepanipyrim		**1**				**0**					1			1	1	**1**					**0**					**0**

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228	131-72-6	Meptyldinocap		**0**				**0**										**0**					**0**					**0**
229		Mercury and its compounds	x	**2**			1	**1**										**0**					**0**		1			**1**
230	139968-49-3	Metaflumizone		**1**				**0**										**0**	1	1		1	**1**					**0**
231	137-41-7	Metam-potassium		**1**				**0**					1					**1**					**0**					**0**
232	137-42-8	Metam-sodium		**1**				**0**					1				1	**1**					**0**					**0**
233	18691-97-9	Methabenzthiazuron		**1**				**0**										**0**				1	**1**					**0**
234	10265-92-6	Methamidophos		**3**		1	1	**1**										**0**				1	**1**		1	X		**1**
235	950-37-8	Methidathion		**2**		1		**1**										**0**				1	**1**					**0**
236	2032-65-7	Methiocarb		**2**		1		**1**										**0**				1	**1**					**0**
237	16752-77-5	Methomyl		**2**		1		**1**										**0**				1	**1**					**0**
238	72-43-5	Methoxychlor		**1**				**0**										**0**					**0**				1	**1**
239	74-83-9	Methyl bromide		**1**				**0**										**0**					**0**	1				**1**
240	9006-42-2	Metiram		**1**				**0**					1			1	1	**1**					**0**					**0**
241	21087-64-9	Metribuzin		**1**				**0**								1		**1**					**0**					**0**
242	7786-34-7	Mevinphos		**2**	1			**1**										**0**				1	**1**					**0**
243	51596-10-2s	Milbemectin		**1**				**0**										**0**				1	**1**					**0**
244	2212-67-1	Molinate		**1**				**0**							1		1	**1**					**0**					**0**

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245	71526-07-3	MON 4660; AD67		**1**				**0**					1					**1**					**0**					**0**
246	6923-22-4	Monocrotophos		**3**		1	1	**1**										**0**				1	**1**		1			**1**
247	300-76-5	Naled		**1**				**0**										**0**				1	**1**					**0**
248	54-11-5	Nicotine		**1**		1	1	**1**										**0**					**0**					**0**
249	150824-47-8	Nitenpyram		**1**				**0**										**0**				1	**1**					**0**
250	98-95-3	Nitrobenzene		**1**				**0**							1		1	**1**					**0**					**0**
251	121451-02-3	Noviflumuron		**1**				**0**					1					**1**					**0**					**0**
252	1113-02-6	Omethoate		**3**		1		**1**									1	**1**				1	**1**					**0**
253	19044-88-3	Oryzalin		**1**				**0**					1					**1**					**0**					**0**
254	19666-30-9	Oxadiazon		**1**				**0**					1					**1**					**0**					**0**
255	23135-22-0	Oxamyl		**2**	1		1	**1**										**0**				1	**1**					**0**
256	301-12-2	Oxydemeton-methyl		**2**		1		**1**										**0**				1	**1**					**0**
257	42874-03-3	Oxyfluorfen		**1**				**0**					1					**1**					**0**					**0**
258		Paraffin oils; mineral oils	**x**	**1**				**0**			1							**1**					**0**					**0**
259	1910-42-5	Paraquat dichloride / Paraquat dichloride >276g/L		**2**			1	**1**										**0**					**0**		1	CF		**1**
260	56-38-2	Parathion		**3**	1			**1**										**0**				1	**1**		1			**1**

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261	298-00-0	Parathion-methyl		**2**	1		1	**1**										**0**					**0**		1	X		**1**
262	87-86-5	PCP; Pentachlorphenol		**3**		1	1	**1**			1		1		1		1	**1**					**0**		1			**1**
263	40487-42-1	Pendimethalin		**1**				**0**										**0**	1	1			**1**					**0**
264	2597-03-7	Phenthoate		**1**				**0**										**0**				1	**1**					**0**
265	298-02-2	Phorate		**2**	1			**1**										**0**				1	**1**					**0**
266	732-11-6	Phosmet		**1**				**0**										**0**				1	**1**					**0**
267	13171-21-6	Phosphamidon		**3**	1			**1**										**0**				1	**1**		1	X		**1**
268	7803-51-2	Phosphine		**1**			1	**1**										**0**					**0**					**0**
269	23103-98-2	Pirimicarb		**2**				**0**					1					**1**		1	1		**1**					**0**
270	29232-93-7	Pirimiphos-methyl		**1**				**0**										**0**				1	**1**					**0**
271	299-45-6	Potasan		**1**			1	**1**										**0**					**0**					**0**
272	23031-36-9	Prallethrin		**1**				**0**										**0**				1	**1**					**0**
273	32809-16-8	Procymidone		**1**				**0**					1		1		1	**1**					**0**					**0**
274	41198-08-7	Profenofos		**1**				**0**										**0**				1	**1**					**0**
275	139001-49-3	Profoxydim		**1**				**0**									1	**1**					**0**					**0**
276	1918-16-7	Propachlor		**1**				**0**					1					**1**					**0**					**0**
277	2312-35-8	Propargite		**2**				**0**					1					**1**	1		1		**1**					**0**

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278	31218-83-4	Propetamphos		1		1		1										0					0					0
279	60207-90-1	Propiconazole		1				0							1			1					0					0
280	12071-83-9	Propineb		1				0					1					1					0					0
281	114-26-1	Propoxur		2				0					1					1				1	1					0
282	75-56-9	Propylene oxide, Oxirane		1				0			1		1	1				1					0					0
283	189278-12-4	Proquinazid		1				0								1		1					0					0
284	34643-46-4	Prothiofos		1				0										0	1		1		1					0
285	123312-89-0	Pymetrozine		1				0					1					1					0					0
286	77458-01-6	Pyraclofos		1				0										0				1	1					0
287	129630-19-9	Pyraflufen-ethyl		1				0					1					1					0					0
288	6814-58-0	Pyrazachlor		1				0					1					1					0					0
289	13457-18-6	Pyrazophos		1				0										0				1	1					0
290	108-34-9	Pyrazoxon		1			1	1										0					0					0
291	8003-34-7	Pyrethrins, Pyrethrum extract		1				0										0				1	1					0
292	96489-71-3	Pyridaben		1				0										0				1	1					0
293	179101-81-6	Pyridalyl		1				0										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 Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS+ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS+ muta (1A, 1B)	GHS+ repro (1A ,1B)	EU EDC	GHS+ C2 & R2	**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**
294	119-12-0	Pyridiphenthion, Pyridaphenthion		1				0										0				1	1					0
295	105779-78-0	Pyrimidifen		1			1	1										0					0					0
296	13593-03-8	Quinalphos		2				0									1	1				1	1					0
297	2797-51-5	Quinoclamine		1				0										0				1	1					0
298	148-24-3	Quinolin-8-ol; 8-hydroxyquinoline		1				0							1			1					0					0
299	124495-18-7	Quinoxyfen		1				0										0	1		1		1					0
300	119738-06-6	Quizalofop-p-tefuryl		1				0									1	1					0					0
301	10453-86-8	Resmethrin		2				0					1				1	1				1	1					0
302	83-79-4	Rotenone		1				0										0				1	1					0
303	105024-66-6	Silafluofen		2				0							1			1				1	1					0
304	122-34-9	Simazine		1				0									1	1					0					0
305	143-33-9	Sodium cyanide		1		1		1										0					0					0
306	62-74-8	Sodium fluoroacetate (1080)		1	1		1	1										0					0					0
307	187166-15-0	Spinetoram		1				0										0				1	1					0
308	168316-95-8	Spinosad		1				0										0				1	1					0
309	148477-71-8	Spirodiclofen		1				0			1		1		1			1					0					0

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	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS+ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS+ muta (1A, 1B)	GHS+ repro (1A ,1B)	EU EDC	GHS+ C2 & R2	**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**
310	57-24-9	Strychnine		1		1		1										0					0					0
311	4151-50-2	Sulfluramid		1				0										0					0		1		1*	1
312	3689-24-5	Sulfotep		1	1			1										0					0					0
313	946578-00-3	Sulfoxaflor		1				0										0				1	1					0
314	102851-06-9	Tau-fluvalinate		1			1	1										0					0					0
315	21564-17-0	TCMTB		1			1	1										0					0					0
316	107534-96-3	Tebuconazole		2			1	1									1	1					0					0
317	96182-53-5	Tebupirimifos		2	1			1										0		1	1		1					0
318	79538-32-2	Tefluthrin		2		1	1	1										0				1	1					0
319	3383-96-8	Temephos		1				0										0				1	1					0
320	149979-41-9	Tepraloxydim		1				0									1	1					0					0
321	13071-79-9	Terbufos		2	1			1										0					0		1			1
322	2593-15-9	Terrazole; Etridiazole		1				0					1					1					0					0
323	22248-79-9	Tetrachlorvinphos		2				0					1					1				1	1					0
324	112281-77-3	Tetraconazole		1				0									1	1					0					0
325	7696-12-0	Tetramethrin		1				0										0				1	1					0
326	148-79-8	Thiabendazole		1				0					*1*		1	1		1					0					0

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	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS⁺ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS⁺ muta (1A, 1B)	GHS⁺ repro (1A ,1B)	EU EDC	GHS⁺ C2 & R2	**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**
327	111988-49-9	Thiacloprid		**1**				**0**					1		1			**1**					**0**					**0**
328	153719-23-4	Thiamethoxam		**1**				**0**										**0**				1	**1**					**0**
329	59669-26-0	Thiodicarb		**3**		1		**1**					1					**1**				1	**1**					**0**
330	39196-18-4	Thiofanox		**2**		1		**1**										**0**				1	**1**					**0**
331	640-15-3	Thiometon		**2**		1		**1**										**0**				1	**1**					**0**
332	23564-05-8	Thiophanate-methyl		**1**				**0**					1			1		**1**					**0**					**0**
333	62-56-6	Thiourea		**1**				**0**									1	**1**					**0**					**0**
334	137-26-8	Thiram		**2**			1	**1**						1				**1**					**0**					**0**
335	137-26-8	Thiram in formulations with benomyl and carbofuran		**1**				**0**										**0**					**0**		1	X		**1**
336	129558-76-5	Tolfenpyrad		**1**				**0**										**0**	1		1		**1**					**0**
337	731-27-1	Tolylfluanid		**2**			1	**1**					1					**1**					**0**					**0**
338	66841-25-6	Tralomethrin		**1**				**0**										**0**				1	**1**					**0**
339	2303-17-5	Tri-allate		**1**				**0**										**0**		1	1		**1**					**0**
340	55219-65-3	Triadimenol		**1**				**0**							1			**1**					**0**					**0**
341	24017-47-8	Triazophos		**1**		1		**1**										**0**					**0**					**0**
342	78-48-8	Tribufos, Tribuphos		**1**				**0**					*1*					**1**					**0**					**0**

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	CAS number	**Pesticide**	Grouped, see Table 3.	**Sum of max=1 in Groups 1-4**	WHO Ia	WHO Ib	H330	**max = 1**	EPA carc	IARC carc	GHS+ carc (1A, 1B)	IARC prob carc	EPA prob likel carc	GHS+ muta (1A, 1B)	GHS+ repro (1A ,1B)	EU EDC	GHS+ C2 & R2	**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**
343		Tributyltin compounds	x	2				0									1	1					0		1			1
344	52-68-6	Trichlorfon		3				0					*1*				1	1				1	1		1			1
345	76-03-9	Trichloroacetic acid		1				0									1	1					0					0
346	81412-43-3	Tridemorph		1				0							1			1					0					0
347	68694-11-1	Triflumizole		1				0							1			1					0					0
348	1582-09-8	Trifluralin		2				0									1	1	1				1					0
349	126535-15-7	Triflusulfuron-methyl		1				0								1		1					0					0
350	37248-47-8	Validamycin		1				0										0				1	1					0
351	2275-23-2	Vamidothion		2		1		1										0				1	1					0
352	50471-44-8	Vinclozolin		1				0							1		1	1					0					0
353	81-81-2	Warfarin		2		1	1	1							1			1					0					0
354	2655-14-3	XMC		1				0										0				1	1					0
355	23783-98-4	Z-Phosphamidon		1	1			1										0					0					0
356	1315501-18-8	zeta-Cypermethrin		1				0										0				1	1					0
357	1314-84-7	Zinc phosphide		1		1		1										0					0					0
358	137-30-4	Ziram		1			1	1										0					0					0

GHS+: This list uses the EU and the Japan GHS (Global Harmonized System) for identification of pesticides classified as GHS carc (1A, 1B), GHS muta (1A, 1B), GHS repro (1A ,1B) and C2 & R2

X: Annex III of the Rotterdam Convention includes certain specific formulations.

CF: Formulations at or above the specified concentration have been agreed by the Rotterdam COP to meet the criteria for listing, but are not yet formally listed

C PIC: agreed by the PIC Convention's Chemical Review Committee and the Conference of the Parties as meeting the criteria of the Convention but yet not formally listed

C POP: agreed by the POPs Chemical Review Committee and the Conference of the Parties as meeting the criteria of the Stockholm Convention but yet not formally listed

* Although sulfluramid is not specially listed under the Stockholm Convention it is regarded by the Stockholm COP as being listed because it is derived from and breaks down into substances that are listed (PFOS and salts).

GHS (EU, Japan) C2 & R2: The combination-criterion GHS C2 & R2 was used by the EU as an interim criterion to indicate possible endocrine disrupting (ED) pesticides

EPA prob likel carc: Italic "*1*" stands for classified by EPA as "Likely to be Carcinogenic to Humans: At High Doses"

EU EDC: ED criteria met according to points 3.6.5 and/or 3.8.2 of Annex II of Regulation (EC) 1107/2009 as amended by Commission Regulation (EU) 2018/605

** This lists uses the same classification for hydrogen cyanide as for calcium cyanide. According to WHO (2019) Calcium cyanide reacts with moisture to produce hydrogen cyanide gas. Hydrogen cyanide is fatal if swallowed, in contact with skin or if inhaled. In liquid form this substance is also fatal if swallowed or in contact with skin.