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Technical work: assessment of alternatives to DDT

Report on the assessment of chemical alternatives to DDT

Note by the Secretariat

A report on the assessment of chemical alternatives to DDT was developed by the Persistent Organic Pollutants Review Committee at its eighth meeting on the basis of the report on the assessment of chemical alternatives to endosulfan and DDT[1] referred to in document UNEP/POPS/POPRC.8/9. The report is set out in the annex to the present note; it has not been formally edited.

[1] UNEP/POPS/POPRC.8/INF/12.

Annex

Report on the assessment of chemical alternatives to DDT

19 October 2012

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I. Disclaimer

1. This report provides hazard-based information on the alternatives with respect to the POP criteria in Annex D of the Stockholm Convention and other relevant hazard criteria. It is important to note that the assessment should not be seen as a comprehensive and in depth assessment of all available information as only a limited number of databases have been consulted (as indicated in section IV of the report).

2. The fact sheets (compiled in the background document), on which this report is based, provide an analysis on a screening level as to whether or not an insecticide meets the numerical thresholds in Annex D, but does not analyze monitoring data or other evidence as provided for in Annex D. So failure to meet the thresholds should be considered as a likelihood rather than as evidence that the insecticide is not a POP.

3. Parties may use this report when choosing alternatives to DDT as a primary source of information. It is strongly recommended that further assessment is carried out within their national framework of authorization. In addition, substances which have been identified here as not likely to meet all Annex D criteria, may still exhibit hazardous characteristics that should be assessed by Parties before considering such substances as a suitable alternative.

II. Background and proposed results

4. By its decision SC-5/6 on DDT, the COP also requested the POPRC, beginning at its eighth meeting, to assess the alternatives to DDT in accordance with the general guidance on considerations related to alternatives and substitutes for listed persistent organic pollutants and candidate chemicals on the basis of factual information provided by parties and observers.

5. The DDT expert group established by the Conference of the Parties on Persistent Organic Pollutant assesses scientific, technical and economic information of DDT including that of availability and accessibility of alternatives for the evaluation of continued need of DDT for disease vector control. The work of the Committee focused on the Persistent Organic Pollutant characteristics of the alternatives in order to facilitate the assessment by the DDT expert group and to prevent duplication of the work carried out by the DDT expert group

6. At its seventh meeting, the POPRC reviewed the information on insecticides recommended by the World Health Organization (WHO) for disease vector control in in-door residual spraying as alternatives to DDT[1] and adopted decision POPRC-7/8 which set out a workplan and terms of reference for the intersessional work related to the assessment of alternatives to DDT. Both workplans and the present status of the subsequent steps within these two workplans are provided in Annex I, as well as the relationships between the identified steps and the chapters of this report.

7. This report addresses the various items identified in the agreed workplans with the aim to:

a) Assess the POP characteristics and other hazard indicators of the insecticides recommended by WHO for disease vector control in in-door residual spraying as alternatives to DDT.

8. This report for the consideration of the POPRC at its eighth meeting provides information on the likelihood of substances to be a POP or not to be a POP.

9. It is important to note that the assessment of the POP characteristics and other hazard indicators of the alternatives should not be seen as a comprehensive and in depth assessment of all available information as only a limited number of databases have been consulted as indicated in section III of the report.

10. Parties may use this report when choosing alternatives to DDT as a primary source of information. This report provides hazard-based information on the alternatives with respect to the POP criteria in Annex D of the Stockholm Convention and other relevant hazard criteria. The fact sheets, on which this report is based, provide an analysis on a screening level as to whether or not an insecticide meets the numerical thresholds in Annex D of the Stockholm Convention, but does not analyze monitoring data or other evidence as provided for in Annex D. So failure to meet the thresholds should not be taken as evidence that the insecticide is not a POP. In addition, substances which in this report are not likely to meet all Annex D criteria, may still exhibit hazardous

[1] UNEP/POPS/POPRC.7/INF19.

characteristics that should be assessed by Parties before considering such substances as a suitable alternative.

11. The screening assessment on the 11 WHO recommended alternatives for DDT identified Bifenthrin as a substance that may meet all the POPs criteria but have equivocal or insufficient data. The other 10 substances were considered not to meet all Annex D criteria.

III. Methodology for the assessment of persistent organic pollutant characteristics and identification of other hazard indicators for the assessment of chemical alternatives to DDT

3.2 4.1 Introduction

12. At its seventh meeting, the POPRC decided to gather further information on alternatives to DDT. Therefore Decision POPRC-7/8 set out a workplan and terms of reference for the intersessional work related to the assessment of alternatives to DDT (cf. Annex I).

13. This chapter addresses item 1 of the agreed workplans for DDT: Develop a methodology for the assessment of persistent organic pollutant characteristics and other hazard indicators.

3.3 Decision on properties to be considered:

14. **Substance identity:** IUPAC name, CAS No., molecular weight, chemical structure, chemical group

15. **Physical-chemical properties:** Water solubility, vapour pressure, Henry´s Law Constant, log Kow, log Kaw, log Koa

16. **Bioaccumulation:** Gather information on log Kow, BCF and additional information like modelled data (PB-score).

17. **Persistence:** Abiotic and biotic degradation, information on half-lives in water, sediment and soil, information on metabolites (if available)

18. **Long-range environmental transport (LRT):** DT50 in air (photo-oxidation, AOPWIN, EPI Suite[2]), OECD Pov and LRT Screening Tool (Characteristic Travel Distance, Transfer Efficiency)

19. The OECD "Pov and LRT Screening Tool"[3] has been developed with the aim of using multimedia models for estimating overall persistence (Pov) and long-range transport potential (LRT) of organic chemicals at a screening level in the context of PBTs/POPs assessments. The tool requires degradation half-lives in air, water and soil and partition coefficients between air and water (Kaw) and between octanol and water (Kow). The Tool calculates metrics of Pov and LRT from a multimedia chemical fate model, and provides a graphical presentation of the results. CTD (characteristic travel distance is a transport-oriented LRT indicator and quantifies the distance from the point of release to the point at which the concentration has dropped to 1/e or about 37% it its initial value. TE (transfer efficiency) is target oriented and focused on how much chemical reaches a certain distant target (Wegmann, 2009) [4].

20. The results are also displayed graphically (x=Pov, y= CTD or TE) and the calculations for the substance are located in one of the four quadrants. The substance can be compared to reference chemicals (POPs). The criteria lines for the quadrants were not modified and take as proposed in the tool (Pov limit: 195 days, CTD limit: 5096 km, TE limit: 2.25%). According to Wegmann (2009) compounds that are less problematic from an environmental exposure point of view are in the bottom-left corner (low Pov, low LRT), while substances of environmental concern are found in the upper right region (high Pov, high LRT).

21. **Ecotoxicity hazards**: Focus on classification (UN-GHS system) and (chronic) limit values, pollinator toxicity (relevant only for endosulfan alternatives). As regards pollinator toxicity, the following data on the intrinsic toxicity (hazard criteria) of the substances to adult honeybees was collected: LD50 contact and LD50 oral [µg a.s./bee, usually 48 h]. They are the standard toxicity figures for bees and are available for the vast majority of insecticides and are the basic requirement for all pesticides in the EU (see e.g. EPPO 170 2010[5]). The disadvantage of these data is that they reflect

[2] http://www.epa.gov/oppt/exposure/pubs/episuite.htm

[3] http://www.oecd.org/document/24/0,3343,en_2649_34379_45373336_1_1_1_1,00.html

[4] Wegmann F. Cavin L, MacLeod M, Scheringer M, Hungerbühler K. (2009) Environmental Modeling & Software 24, 228-237

[5] http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2338.2010.02418.x/abstract

intrinsic toxicity and not effects seen under more realistic conditions. Furthermore some insecticides, like insect growth regulators and substances with a similar mode of action, pose a risk to the larval development of bees (and consequently to the development of the bee hive) but are not toxic to adults – the overall bee toxicity of these substances will be underestimated if only toxicity to adults is considered. The advantage is that hazard data are comparable among substances and independent of the conditions of use of a substance. The classification of bee toxicity in the "screening risk assessment" of document UNEP/POPS/POPRC.6/INF/12 is based on an IOBC classification[6] that obviously took into account higher-tier results (semi-field and/or field data) and therefore is a risk indicator. The disadvantage of this classification is that it is dependent on the dosage applied and crop type. This may be the reason that contradictory information was found for several substances. Furthermore, probably for many of the substances no IOBC classification is available. It may reflect more realistic conditions (i.e. some substances are of high toxicity to bees, however, under (semi-)field conditions no significant effects are recognised). However, under field conditions some substances are more toxic than expected because of their synergistic interaction with other stressors such as parasites and diseases. In summary, because some pesticides can potentially tip the balance for bees though their sublethal neurological and immune effects, and because the effects on larvae are not taken into account, it is likely that the hazard information on bees underestimates the real effect. Note: In the Footprint database only one LD50 value for bees is given – either oral or contact.

22. **Toxicity hazards:** Focus on classification (GHS system) and long term limit values and consider other hazards as indicated below:

a) Acute systemic toxicity, sensitization, dermal / respiratory STOT RE or SE, mutagenicity, carcinogenicity, reproductive toxicity, developmental toxicity, endocrine disruptor, immune suppression, neuro-toxicity, acceptable exposure level (AEL) long term.

3.4 Databases consulted

23. In order to assess the selected alternative substances for endosulfan and DDT within the given time frame and resources preference to governmental reports and evaluated, peer reviewed data were given. Therefore databases were split into first line and second line references, the later were consulted if first line references yielded insufficient information.

3.4.1 First line references:

a) EU Biocides Review: http://ec.europa.eu/environment/biocides/annexi_and_ia.htm

b) ESIS: http://esis.jrc.ec.europa.eu/index.php?PGM=cla

BPD (Biocidal Products Directive) active substances listed in Annex I or IA of Directive 98/8/EC or listed in the so-called list of non-inclusions.

C&L (Classification and Labelling, Annex VI to EU CLP Regulation 1272/2008)

Risk Assessment Reports (RAR)

c) EFSA

http://ec.europa.eu/food/plant/protection/evaluation/exist_subs_rep_en.htm

http://dar.efsa.europa.eu/dar-web/provision

d) EU Endocrine Disruption Database

http://ec.europa.eu/environment/endocrine/strategy/short_en.htm

e) US-EPA: RED, Factsheets

http://www.epa.gov/pesticides/chemicalsearch

http://www.epa.gov/pesticides/factsheets/npic.htm

f) WHO/EPS

http://www.who.int/whopes/quality/en/

g) EPI SUITE:

[6] [IOBC 2005] IOBC wprs Working Group "Pesticides and Beneficial Organisms & IOBCwprs Commission "IP Guidelines and Endorsement" (05.12.2005 Comm.)

http://www.epa.gov/oppt/exposure/pubs/episuitedl.htm

h) IARC:

http://monographs.iarc.fr/ENG/Monographs/PDFs/index.php
International limit values (working place)

http://www.dguv.de/ifa/de/gestis/limit_values/index.jsp
PPDB

http://sitem.herts.ac.uk/aeru/footprint/index2.htm

3.4.2 Second line references:

a) CLP inventory (for endpoints not covered by ESIS)

http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database

b) ECETOC

http://www.ecetoc.org/jacc-reports

c) ECOTOX

http://cfpub.epa.gov/ecotox/

d) EXTOXNET

http://extoxnet.orst.edu/

e) HSDB

http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB

f) OECD eChemPortal

http://www.echemportal.org/echemportal/page.action?pageID=9

g) OECD Pov and LRTP Tool

http://www.oecd.org/LongAbstract/0,3425,en_2649_34379_40718985_119669_1_1_1,00.html

h) PAN

http://www.pesticideinfo.org/Index.html

i) WHO/EHC

http://www.who.int/ipcs/publications/ehc/en/index.html

3.5 Decision on the representation of the information on the endpoints, handling of conflicting results and integration of the data

24. For each substance a POP summary document was compiled. The summary document is a concise summary of qualitative information on the endpoints indicated above and has been mainly derived from governmental and international reports (substance evaluation). Data sources are differentiated into first line and second line references, the later were consulted if first line references yielded insufficient information. Conflicting results were not sorted out, but are presented as such, eventually with some explaining words indicating the overall line of evidence.

25. The summary documents provides an indication as to whether or not the insecticide meets the numerical thresholds in Annex D of the Stockholm Convention, but does not analyze monitoring data or other evidence as provided for in Annex D, so failure to meet the thresholds should not be taken as a determination that the insecticide is not a POP.

26. As an overview one large table with summary of endpoints of all alternative substances (Word document) and its comparison against the Annex D criteria is compiled. Conflicting results will be presented without explanation. Data presentation in the table is explained in a footnote to that Table.

27. An additional free text summary explaining the overall uncertainties and conclusions is provided as well.

IV. Assessment of the persistent organic pollutant characteristics and other hazard indicators of the chemical alternatives of DDT.

28. For each of the alternative chemicals for DDT as recommended by WHO according to UNEP/POPS/POPRC.7/INF/19 a detailed POP factsheet was compiled[7]. In compilling the data procedure as described for the assessment of alternatives to endosulfan as set out in UNEP/POPS/POPRC8/INF/28 was followed.

4.1 Data availability and uncertainties

29. In general the assessment of the alternative substances was based on evaluated data and governmental reports. However, for some substances particular endpoints were covered with limited data and only one report as indicated in the reference section of the individual POP factsheets. Also, the phase out/ban of certain substances was one reason for the smaller (evaluated) data set. If limited data were available that were reviewed in one report only this may be considered as substantial uncertainty. Evaluation from different bodies often used the same data set/studies but we assumed that the evaluation of the data was independent, giving some reassurance to the conclusions. However it is uncertain if or to which extent evaluations were definitely independent. In some cases metabolites have been included however the data set was not homogenous.

30. Concerning the assessment of LRT not all pesticides justified a full evaluation including the OECD tool. Only if the calculated half-life in air was greater than 24 hours or persistence in the environment indicated stability the multimedia fate model was performed.

31. However, there are several uncertainties associated with the LRT assessment: uncertainties of the input parameters, overestimation of photo-oxidative degradation in air (see Scheringer 2009)[8] as well as CTD and TE might not be in all cases a relevant LRT descriptor (see AMAP, 2009)[9].

32. Also concerning persistence, some chemicals had single DT50 values that exceed the threshold of Annex D. The conclusion based on only one value must be seen with caution.

33. Concerning the toxicity assessment for human health, no human data have been reviewed, the assessment focused on results from laboratory animals submitted for regulatory purposes. Independent, i.e. non-regulatory studies were not included. In addition, it needs to be mentioned that practically no explicit assessment was available for adverse effects on the immune system; and the assessment of endocrine disruption was limited to several substances. It may be expected that substances within one category (organophosphates, carbamates, pyrethroids, benzylurea) show the same toxicological mode of action and therefore a similar toxicological profile. However for several substances within one category different conclusions were drawn with regard to carcinogenicity, developmental toxicity and endocrine disruption. It may well be that the slightly different chemical structures of the substances within one category lead to different effects; for example, experimental data do show differing effects of organophosphates on the nervous system. However it may also well be that the different conclusions were a consequence of different data packages available for the individual substances or simply reproducibility of the study results.

34. Finally, efficacy data determining the application rates and consequent exposure estimates were not considered.

5.3 Results

35. The results of the assessment of the substances are displayed in Annex II. Specific information (factsheets) on all substances is compiled in a separate background document.

36. As explained above and as can be seen from the listing in Annex II, not all aspects of the Annex D screening criteria have been considered. The specific Annex D item is listed in Annex II. Thus, considering also other Annex D items might change the conclusions on certain substances.

[7] UNEP/POPS/POPRC.8/INF/31.

[8] http://onlinelibrary.wiley.com/doi/10.1897/08-324R.1/full

[9] AMAP Assessment 2009 - Persistent Organic Pollutants (POPs) in the Arctic. Science of the Total Environment Special Issue. 408:2851-3051. Elsevier, 2010

5.4 Conclusions of the screening assessment on POPs characteristics of the chemical alternative of DDT

37. Based on the results of the screening assessment the following recommendations are suggested. However, the assessment provides only an indication as to whether or not the insecticide meets the numerical thresholds in Annex D of the Stockholm Convention, and does not analyze monitoring data or other evidence as provided for in Annex D, so failure to meet the thresholds should not be taken as a determination that the insecticide is not a POP. Furthermore, this work is only a first screening indicating the likelihood and not a definite classification of the substances concerning their POP characteristics.

Class 1: Substances that met all Annex D criteria

None

Class 2: Substances that may meet all Annex D criteria but remained undetermined due to equivocal or insufficient data

Bifenthrin

Class 3: Substances that are not likely to fulfil the criteria inAnnex D criteria

Alpha-Cypermethrin, Bendiocarb, Cyfluthrin, Lambda-cyhalothrin, Deltamethrin, Etofenprox, Fenitrothion, Malathion, Primiphos-methyl, Propoxur.

Annex I

Terms of reference for the intersessional work on DDT

(Annex II to decision POPRC-7/8)

1. Develop a methodology for the assessment of persistent organic pollutant characteristics of chemical alternatives to DDT.

2. Assess the persistent organic pollutant characteristics of the chemical alternatives identified in document UNEP/POPS/POPRC.7/INF/19.

3. Provide a report for the consideration of the Committee at its eighth meeting.

Annex II

Results of the assessment

Substance	Chemical group	Bioaccumulation Annex D 1 (c) (i)	Persistence: Annex D 1. (b) (i).	LRT Annex D 1 (d) (iii)	Classification Regulation (EC) No 1272/2008	Pollinator Toxicity	acute syst. Tox.	Sensit. derm./ resp.	STOT SE or RE	Muta.	Carc.	Dev. tox	Repro. Tox.	ED	Adv. eff. to IS	Del. NT	NT	long term AEL [mg/kg bw day]
Alpha-cypermethrin	Pyrethroid	no	no	No	Aquatic acute and chronic cat. 1	LC50: oral: 0.059 µg/bee; contact: 0.033 µg/bee	o3 r?	no	SE3; RE2	no	?	no	no	II	-	no	Crit. Eff.	0.01
Bendiocarb	Carbamate	no	no	No	Aquatic acute and chronic cat. 1, M=100	-	o,r3* d4*	no	no	no	no	no	no	-	-	no	Crit. Eff.	0.0065
Bifenthrin	Pyrethroid	Yes/no Equivocal data set	yes	Yes/no DT50 air<2 days, but high Pov, intermediate concern acc. to OECD model	Proposed: Aquatic acute and chronic cat. 1	LC50: oral: 0.12 µg a.s./bee contact: 0.04-0.11 µg a.s./bee	o,r3	d1	?	no	?	no	no	I	-	no	Crit. Eff.	0.0075
Cyfluthrin	Pyrethroid	No, But log Kow 6	no	No/yes based on DT50 air< 2 days but high transfer efficiency (OECD tool)	Aquatic acute and chronic cat. 1	-	o,r2	no	no	no	no	no	no	-	-	no	Crit. Eff.	r:0.0002 o,d: 0.002
Deltamethrin	Pyrethroid type II	No But log Kow 4.6-6.2	yes but also faster degradation rates reported	no	Aquatic acute and chronic cat. 1	LC50: 0.079µg/bee oral 0.0015µg/bee contact	o,r3	no	no	no	no	no	no	I	-	no	Crit. Eff.	0.0075
Etofenprox	Pyrethroid - ether	no based on one single BCF value	No	No	Aquatic acute and chronic cat. 1	LC50 oral/contact=0.27 and 0.13 µ a.s/bee	no	no	RE2?	no	no	no	no	IIIb	-	no	no	0.03
Fenitrothion	Organo - phosphate	no	no	no	Aquatic acute and chronic cat. 1	LC50: oral: 0.20 µg/bee contact: 0.163µg/bee	o4* d?	?	no	no	no	no	no	I	-	no	Crit. Eff.	0.0013
Lambda-Cyhalothrin	Pyrethroid type II	No but BCF close to 5000 log Kow 5-6.9	No but stable under anaerobic conditions	no	Aquatic acute and chronic cat. 1 (Lambda-Cyhalothrin) high toxicity also reported for the other two substances	LC50: Cyhalothrin: oral: 0.027µg/bee Lambda: oral: 0.91µg/bee, contact: 0.038µg/bee; Gamma: contact: 0.005µg/bee	r2; r1[1] o3 d4	no	no	no	no	no	no	I	-	no	Crit. Eff.	0.0025
Malathion	Organophosphate	no	no	no	Aquatic acute and chronic cat. 1 (M=1000)	LC50: oral: 0.40 µg a.s./bee contact: 0.16µg a.s./bee formulation tested	o4*	skin 1	no	no	no	no	no	II	?	no	Crit. Eff.	0.03
Pirimiphos-methyl	Organophosphate	no	no	no	Aquatic acute and chronic cat. 1	-	o4*	no	no	no	?	no	no	-	-	no	Crit. Eff.	0.004
Propoxur	carbamate	no	No BUT no proof of biodegradation in aquatic environments below a pH value of 7	no	Aquatic acute and chronic cat. 1	LC50: 1.35 µg/bee	o3 r4?	no	no	no	? (US EPA: yes)	no	no	-	-	no	Crit. Eff.	0.005 or 0.02

a.s. ...active substance

yellow: indicate concern

orange: no clear conclusions or limited could be drawn

no: no GHS classification and data supporting no hazard

?: no harmonised GHS classification, but data are reported to possibly support GHS classification or evaluation available with unclear conclusion for adverse effects to the immune system or neurotoxicity.

Crit. Eff.: critical effect

-: no specific data evaluation available

acute syst. Tox. - acute systemic toxicity: EU GHS categories **1**, **2** ,**3**, **4** for oral (**o**), dermal (**d**), respiratory (**r**) exposure. "*****" indicates minimal classification (uncertainty from transposing Dir. 67/548/EC to GHS, Regulation (EC) No 1272/2008)

Sensit. derm./ resp.- Sensitization: EU GHS category **1** for dermal (**d**) or respiratory (**r**) exposure

STOT SE or RE - Specific Target Organ Toxicity: EU GHS categories **1** or **2** for single exposure (**SE**) or repeated exposure (**RE**) or "**no**" GHS classification and data supporting no hazard. "**?"** in case no harmonised GHS classification, but data are reported to possibly support GHS classification. In view of the low AELs for all of the substances STOT RE classification may apply to all of these substances or at least those showing specific neurotoxic effects. However this aspect seems not harmonised yet in the EU-GHS system.

Muta.- Mutagenicity: EU GHS categories **1** or **2** or "**no**" GHS classification and data supporting no hazard. "**?"** in case no harmonised GHS classification, but data are reported to possibly support GHS classification.

Carc.- Carcinogenicity: see Muta.

Dev. Tox.-Developmental Toxicity: see Muta.

Repro. Tox. -Reproductive Toxicity: see Muta

ED -endocrine disruption: EU Endocrine Disruption Database categories 1, 2, 3a or 3b, indicated as **I**, **II**, **IIIa** or **IIIb** to avoid confusion with concept of GHS categories. The European Endocrine Disruption database is considered as primary reference to cover this endpoint. The development and category definition is explained on the respective EU homepage: http://ec.europa.eu/environment/endocrine/strategy/substances_en.htm**. Category 1 -** evidence of endocrine disrupting activity in at least one species using intact animals**; Category 2 -** at least some in vitro evidence of biological activity related to endocrine disruption; **Category 3 -** no evidence of endocrine disrupting activity (3a) or no data available (3b). In case the substance is not listed and no specific data evaluation is available this is indicated in the list with"**-**".In case the substance is not listed but one of the evaluations indicates a specific ED evaluation and conclusion this is indicated with "**no**". The US EPA ED screening program and respective lists are largely based on exposure considerations and data needs rather than observed effects and -together with references to other ED lists- this information is implicit in the POP factsheet under the heading "other information" where the summary of the PAN pesticides network database is reported.

Adv. Eff. to IS - Adverse effects to immune system: In principle from standard animal test endpoints (in specific heamatology, histology and organ weights) indications for adverse effects to the immune system may be apparent. If no such effects were reported in the evaluations screened for the POP factsheet it could be assumed that the substance is without concern for these endpoints. However more specific endpoints may be investigated and required. Therefore in the absence of a specific discussion of the potential for adverse to the immune system a "**-**" is indicated in the summary list as a precautionary consideration. If a discussion is available indicating the presence or absence of specific concern this is indicated with "**yes**" or "**no**", respectively. If a discussion is available with an unclear conclusion this is indicated with "**?**".

Del. NT - delayed neurotoxicity: Specific test guidelines were developed (OECD TG 418 and 419) to test the potential for delayed neurotoxicity in hen. As mentioned in the TGs this effect is recognized as potentially relevant especially for organophosphorus substances. Therefore in the summary list a "**no**" is indicated for all non-organophosphorus substances, though in most cases no specific test for delayed neurotoxicity was available. For all organophosphorous substances in the list negative data were reported for delayed neurotoxicity, therefore also for these a "**no**" is indicated in the summary table. More details may be found in the POP factsheets and the related references.

NT - neurotoxicity: Neurotoxicity may result from clinical, functional, sensory, behavioral or histological and eventually development specific endpoints. In case such endpoints were reported as critical for the derivation of limit values this was indicated in the summary table with "**crit. eff**." If they were only critical with short term exposure this is mentioned in the table, if they were not critical for AEL derivation this is indicated in the summary table with "**no**". More details may be found in the POP factsheets and the related references.

long term AEL- long term acceptable exposure level [mg/kg bw day]: (1) It may be debated if internal or external limit values should be presented in this summary list. The disadvantage of internal (systemic) limit values is that it is not in all evaluations a consistent practice to refine external limit values by oral absorption rates and that the latter may also contain further uncertainties. The advantage of internal limit values is that exposure route specificities may be reduced. In this summary list the internal limit values are presented or the external limit values in case internal values are not specified. However as far as available both values are presented in the POP factsheets. (2) As far as available in the international evaluations and the listed databases the long term internal limit dose value from the latest evaluations will be presented, if necessary specific for exposure route. In case very disparate values are provided in different reviews, the range of the values is listed.

Annex III

Abbreviations

Abbreviation	**Explanation**
AEL	Acceptable Exposure level
ADI	Acceptable daily intake
ACTH	adrenal cortical trophic hormone
Ai	active ingredient
As	active substance
AR	Assessment Report
BAF	bioaccumulation factor
BCF	bioconcentration factor
CS Syndrome	?
Bw	Body weight
CAS	Chemical Abstracts Service
CAR	Competent authority Report
CNS	Central Nervous System
CLP Regulation	Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures
CTD	characteristic travel distance
DAR	Draft Assessment Report
DT50(lab)	period required for 50 percent dissipation (under laboratory conditions)
DT90(lab)	period required for 50 percent dissipation (under laboratory conditions)
EC50	median effective concentration
EbC50	Median affective concentration, growth rate
ErC50	Median effective concentration, biomass
EPPO	European and Mediterranean Plant Protection Organization
EU	European Union
GHS	Globally Harmonized System
EFSA	European Food Safety Authority
IARC	International Agency for Research on Cancer
IOBC	International Organization for Biological Control
H	Henry's Law constant (calculated as a unit less value)
HPV chemical	High production volume chemical

Abbreviation	**Explanation**
LOEL	lowest observable effect level
LRT	long-range transport
Kow	octanol-water partition coefficient
Kaw	air-water partition coefficient
Koa	octanol-air partition coefficient
LLNA	Local Lymph Node Assay
NOAEL	no observed adverse effect level
NOAEC	no observed adverse effect concentration
NOEC	no observed effect concentration
NOErC	no observed effect concentration, growth rate
NOEbC	No observed effect concentration, biomass
(Q)SAR	quantitative structure-activity relationship
OH	Hydroxide
OECD	Organization for Economic Co-operation and Development
PBT	persistent, bioaccumulative, toxic
PPBD	Pesticide Properties DataBase
Pov	Overall Persistence
POD	point of departure
RED	Re-registration Eligibility decision
RfD	Reference Dose
RIVM	Netherlands National Institute of Public Health and Environmental Protection
STOT RE or SE	Specific Target Organ Toxicity-Repeated Exposure or Single Exposure
t½	half-life (define method of estimation)
TE	Transfer Efficiency
TC NES	Technical Committee on New and Existing Substances
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

Abbreviation	**Explanation**
HSDB	Hazardous substance database
LOAEC	lowest observable adverse effect concentration
LOAEL	lowest observable adverse effect level
LC50	lethal concentration, median
LOEC	lowest observable effect concentration

Abbreviation	**Explanation**