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Hoe bang moeten we zijn voor bestrijdingsmiddelen?

Martin van den Berg

Institute for Risk Assessment Sciences (IRAS)

Universiteit Utrecht

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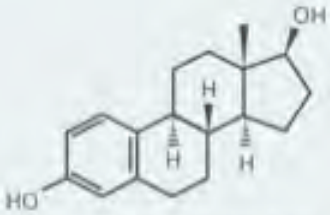
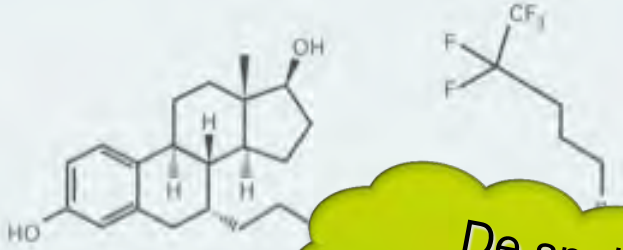
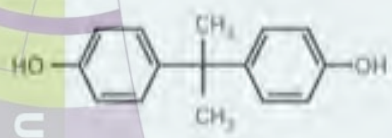


E_2 (17β-estradiol)

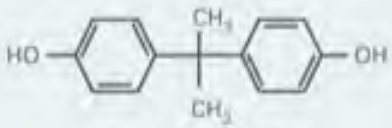


De spelregels van de toxicologie

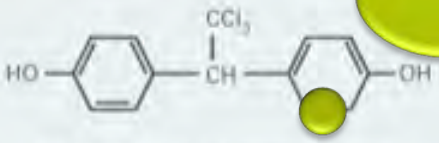
Group 1



BPA (bisphenol A)

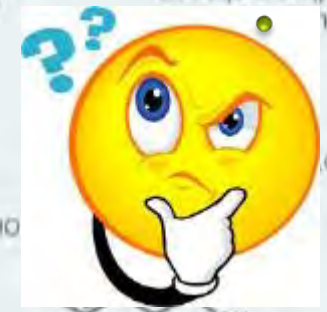


BPAF (bisphenol AF)

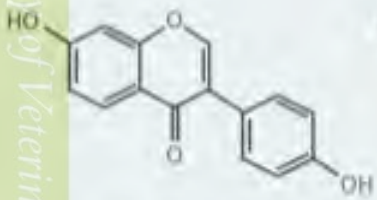


HPTE [2-2-bis(*p*-hydroxyphenyl)-loroethane]

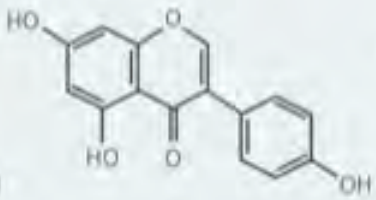
4n-NP (4-*n*-nonylphenol)



Group 2

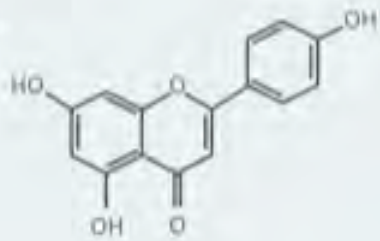


Dai (daidzein)

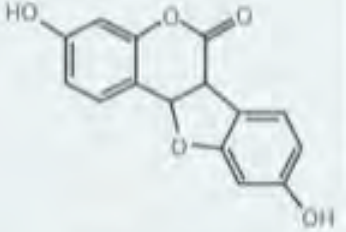


Gen (genistein)

Kaem (kaempferol)

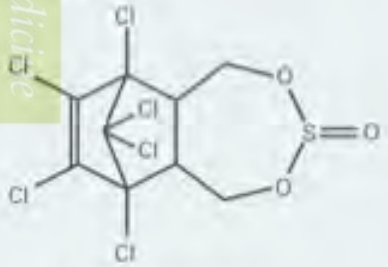


Api (apigenin)



Coum (coumestrol)

Group 3



Endo (endosulfan)

Kep (kepone)

1-BP (1-bromopropane)

Hazard *vs*. Risk

- **Hazard**

(potentieel gevaarlijk voor gezondheid):

= intrinsieke *eigenschap* van een stof

- **Risk (risico):**

= waarschijnlijkheid dat die gevaarlijke eigenschap zich manifesteert bij een bepaalde *blootstelling*

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Risico schatting in de toxicologie voor de mens

1. Identificatie gevaarlijke eigenschap (hazard)
2. Karakterisering eigenschap (dosis-effect)
3. Vaststellen van de blootstelling
4. Vaststellen van het risico

5. Maatregelen om risico te beperken
6. Risico communiceren

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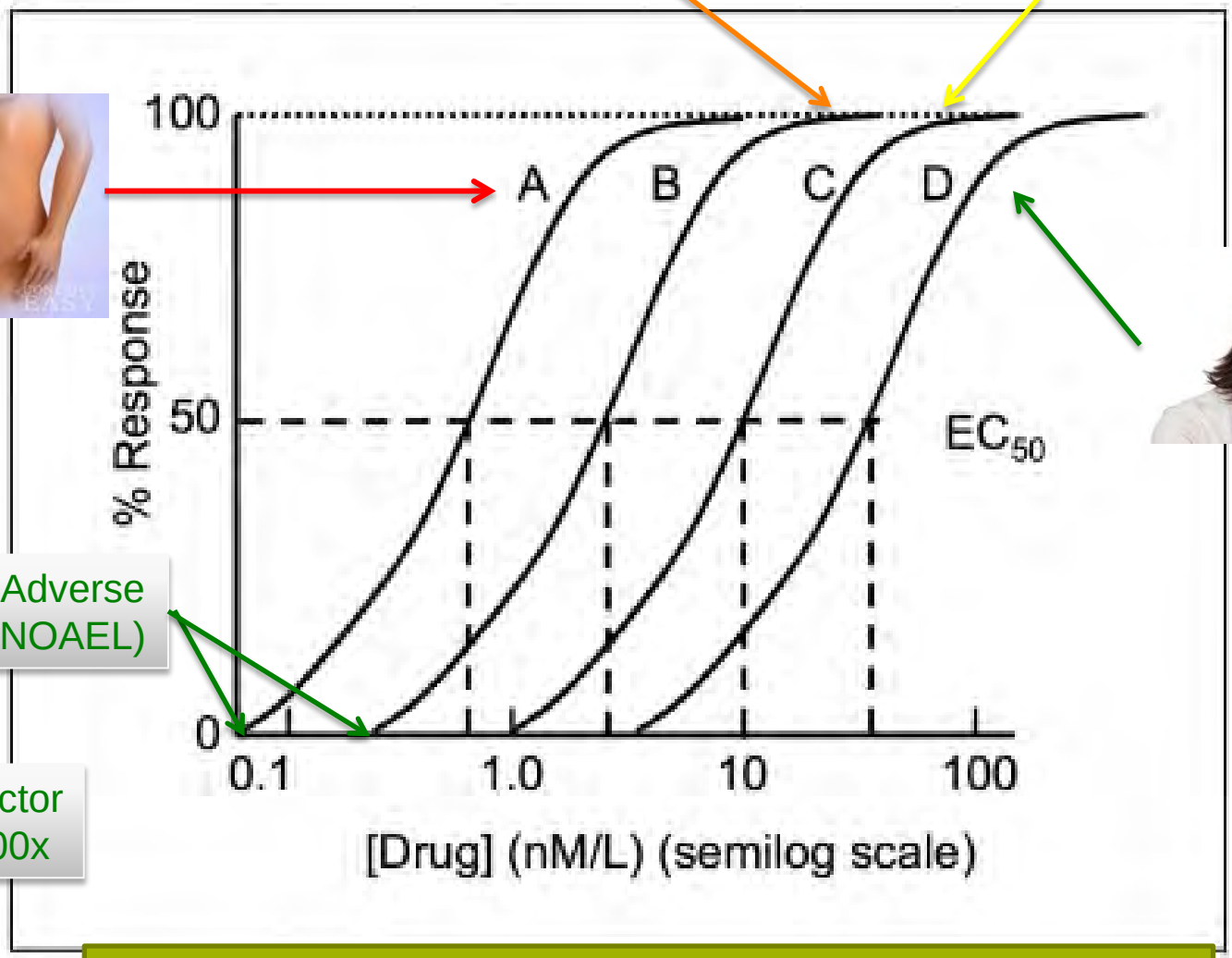


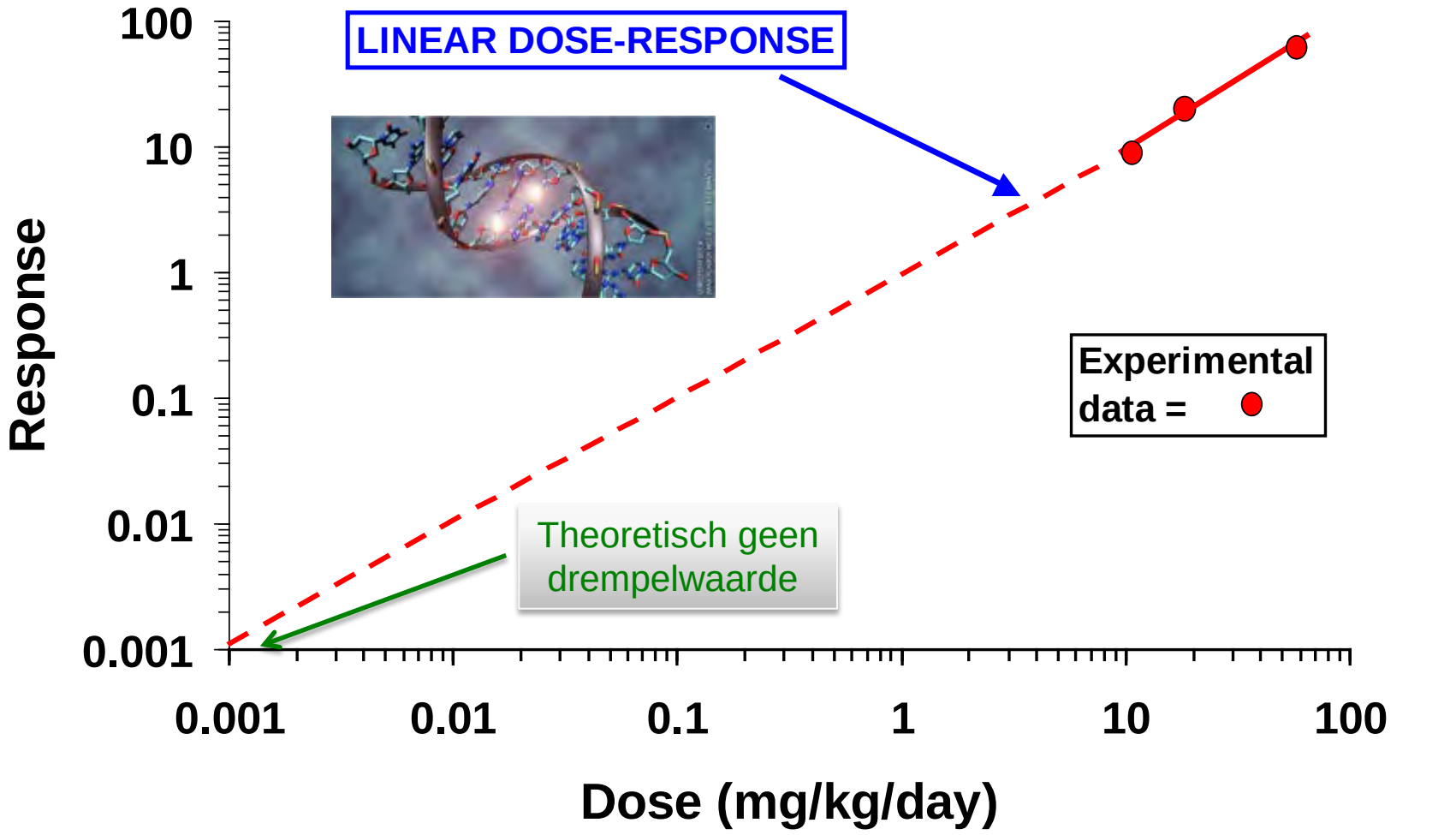
No Observed Adverse Effect Level (NOAEL)

Safety Factor Default 100x

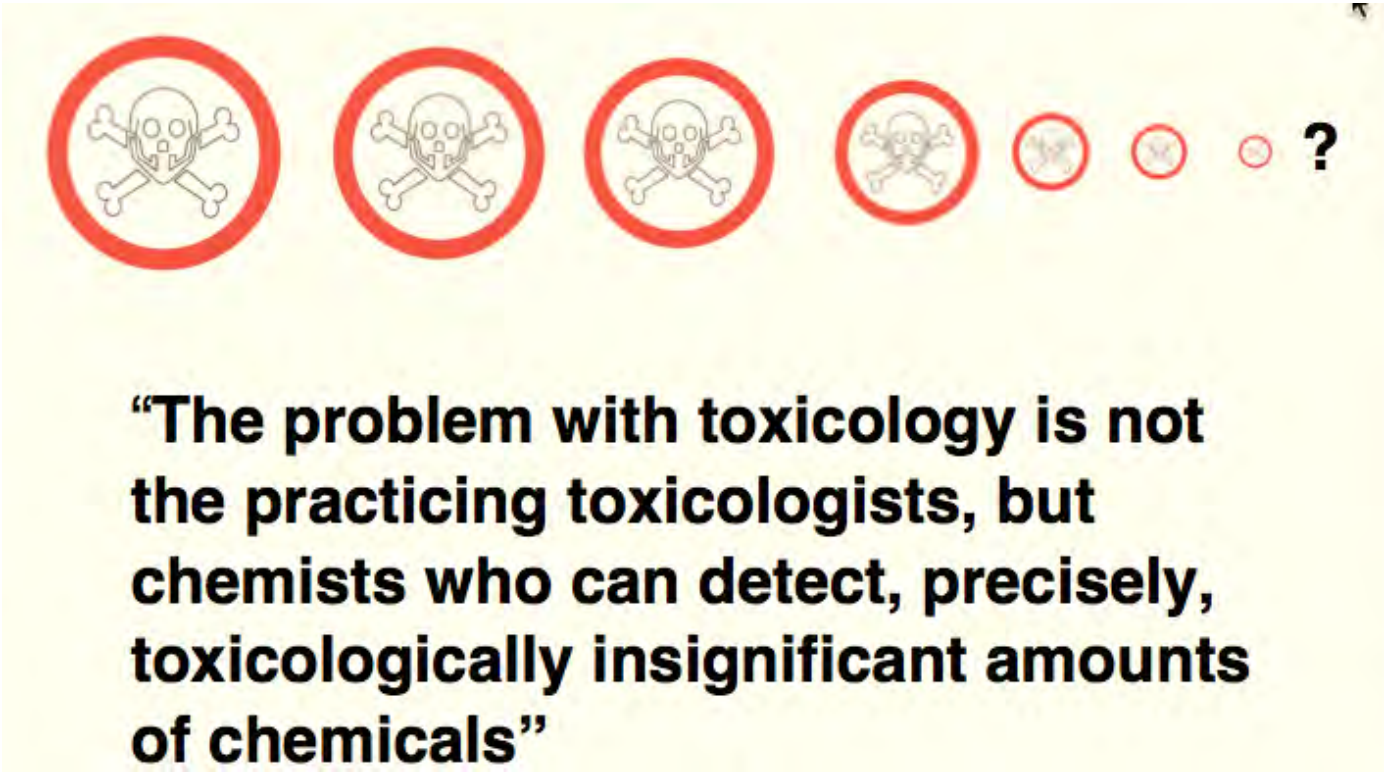
Gevoeligheid voor een stof hangt af van levensfase

Hypothetical dose-response

Bijv. tumoren bij de rat



Acceptabel: 1: 100.00 tot 1.000.000 mensen ontwikkelt een tumor



Rene Truhaut, University of Paris (1909-1994)

Detectie grens tegenwoordig: *femtogram* = **10^{-15} gram**

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International Agency for Research on Cancer

World Health Organization

News

Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate

In March, 2015, 17 experts from 11 countries met at the International Agency for Research on Cancer (IARC; Lyon, France) to assess the carcinogenicity of the organophosphate pesticides tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate (table). These assessments will be published as volume 112 of the IARC Monographs.[1]

The insecticides tetrachlorvinphos and parathion were classified as "possibly carcinogenic to humans" (Group 2B). The evidence from human studies was scarce and considered inadequate. Tetrachlorvinphos induced hepatocellular tumours (benign or malignant) in mice, renal tubule tumours (benign or malignant) in male mice,[2] and spleen haemangioma in male rats. Tetrachlorvinphos is a reactive oxon with affinity for esterases. In experimental animals, tetrachlorvinphos is systemically distributed, metabolised and eliminated in urine. Although bacterial mutagenesis tests were negative, tetrachlorvinphos induced genotoxicity in some assays (chromosomal damage in rats and in vitro) and increased cell proliferation (hyperplasia in rodents). Tetrachlorvinphos is banned in the European Union. In the USA, it continues to be used on animals, including in pet flea collars.

For parathion, associations with cancers in several tissues were observed in occupational studies, but the evidence in humans remains sparse. In mice, parathion increased bronchiolo-alveolar adenoma and/or carcinoma in males, and lymphoma in females. In rats, parathion induced adrenal cortical adenoma or carcinoma (combined),[3] malignant pancreatic tumours, and thyroid follicular cell adenoma in males, and mammary gland adenocarcinoma (after subcutaneous injection in females).[4] Parathion is rapidly absorbed and distributed. Parathion metabolism is similar across species. Although bacterial mutagenesis tests were negative, parathion induced DNA and chromosomal damage in human cells in vitro. Parathion markedly increased rat mammary gland terminal end bud density.[4] Parathion use has been severely restricted since the 1980s.

The insecticides malathion and diazinon were classified as "probably carcinogenic to humans" (Group 2A). Malathion is used in agriculture, public health, and residential insect control. It continues to be produced in substantial volumes throughout the world. There is limited evidence in humans for the carcinogenicity of malathion. Case-control analyses of occupational exposures reported positive associations with non-Hodgkin lymphoma in the USA,[5] Canada,[6] and Sweden,[7] although no increased risk of non-Hodgkin lymphoma was observed in the large Agricultural Health Study cohort (AHS). Occupational use was associated with an increased risk of prostate cancer in a Canadian case-control study[8] and in the AHS, which reported a significant trend for aggressive cancers after adjustment for other pesticides.[9] In mice, malathion increased hepatocellular adenoma or carcinoma (combined).[10] In rats, it increased thyroid carcinoma in males, hepatocellular adenoma or carcinoma (combined) in females, and mammary gland adenocarcinoma after subcutaneous injection in females.[4] Malathion is rapidly absorbed and distributed. Metabolism to the bioactive metabolite, malaoxon, is similar across species. Malaoxon strongly inhibits esterases; atropine reduced carcinogenesis-related effects in one study.[4] Malathion induced DNA and chromosomal damage in humans, corroborated by studies in animals and in vitro. Bacterial mutagenesis tests were negative. Compelling evidence supported disruption of hormone pathways. Hormonal effects probably mediate rodent thyroid and mammary gland proliferation.

Diazinon has been applied in agriculture and for control of home and garden insects. There was limited evidence for diazinon carcinogenicity in humans. Positive associations for non-Hodgkin lymphoma, with

Activity (current status)		Evidence in humans (cancer sites)	Evidence in animals	Mechanistic evidence	Classification*
Tetrachlorvinphos	Insecticide (restricted in the EU and for most uses in the USA)	Inadequate	Sufficient	–	2B
Parathion	Insecticide (restricted in the USA and EU)	Inadequate	Sufficient	–	2B
Malathion	Insecticide (currently used; high production volume chemical)	Limited (non-Hodgkin lymphoma, prostate)	Sufficient	Genotoxicity, oxidative stress, inflammation, receptor-mediated effects, and cell proliferation or death	2A†
Diazinon	Insecticide (restricted in the USA and EU)	Limited (non-Hodgkin lymphoma, leukaemia, lung)	Limited	Genotoxicity and oxidative stress	2A†
Glyphosate	Herbicide (currently used; highest global production volume herbicide)	Limited (non-Hodgkin lymphoma)	Sufficient	Genotoxicity and oxidative stress	2A†

EU=European Union. *See the International Agency for Research on Cancer (IARC) preamble for explanation of classification system (amended January 2006). †The 2A classification of diazinon was based on limited evidence of carcinogenicity in humans and experimental animals, and strong mechanistic evidence; for malathion and glyphosate, the mechanistic evidence provided independent support of the 2A classification based on evidence of carcinogenicity in humans and experimental animals.

Table: IARC classification of some organophosphate pesticides

www.thelancet.com/oncology Published online March 20, 2014 http://dx.doi.org/10.1016/S1470-2045(15)70134-8

Lancet Oncol 2015; Published Online March 20, 2015 http://dx.doi.org/10.1016/S1470-2045(15)70134-8

For more on the **IARC Monographs** see http://monographs.iarc.fr

Upcoming meetings
June 2–9, 2015, Volume 113: Some organochlorine insecticides and some chlorophenoxy herbicides
Oct 6–13, 2015, Volume 114: Red meat and processed meat

Monograph Working Group Members
A Blair (USA)—Meeting Chair; L Fritschi (Australia); JMcLaughlin; C M Sergi (Canada); GM Calaf (Chile); F Le Curieux (Finland); I Baldi (France); F Forastiere (Italy); H Kromhout (Netherlands); A 't Mannetje (New Zealand); T Bodegraven [unable to attend] (Nicaragua); P Egeghy [unable to attend]

Bestrijdingsmiddelen kankerverwekkend?

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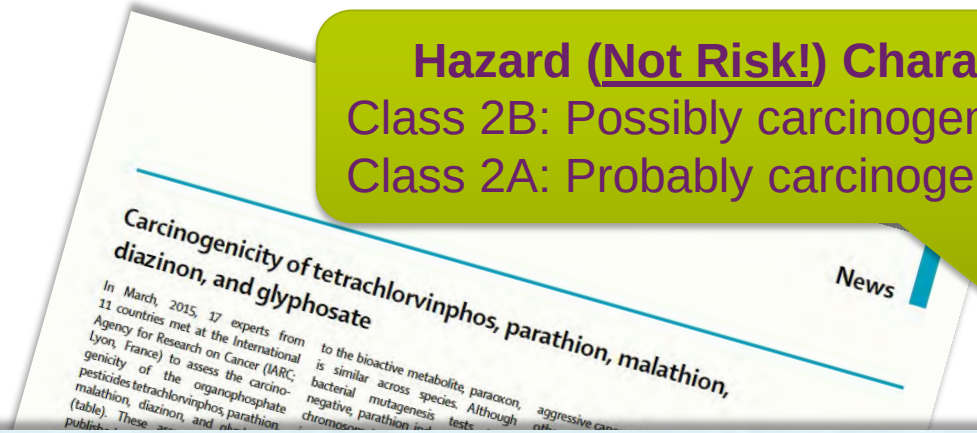
Hazard (Not Risk!) Characterization

Class 2B: Possibly carcinogenic in humans

Class 2A: Probably carcinogenic in humans



News

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	Activity (current status)	Evidence in humans (cancer sites)	Evidence in animals	Mechanistic evidence	Classification*
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Table: **IARC classification of some organophosphate pesticides**

International Agency for Research on Cancer

World Health Organization

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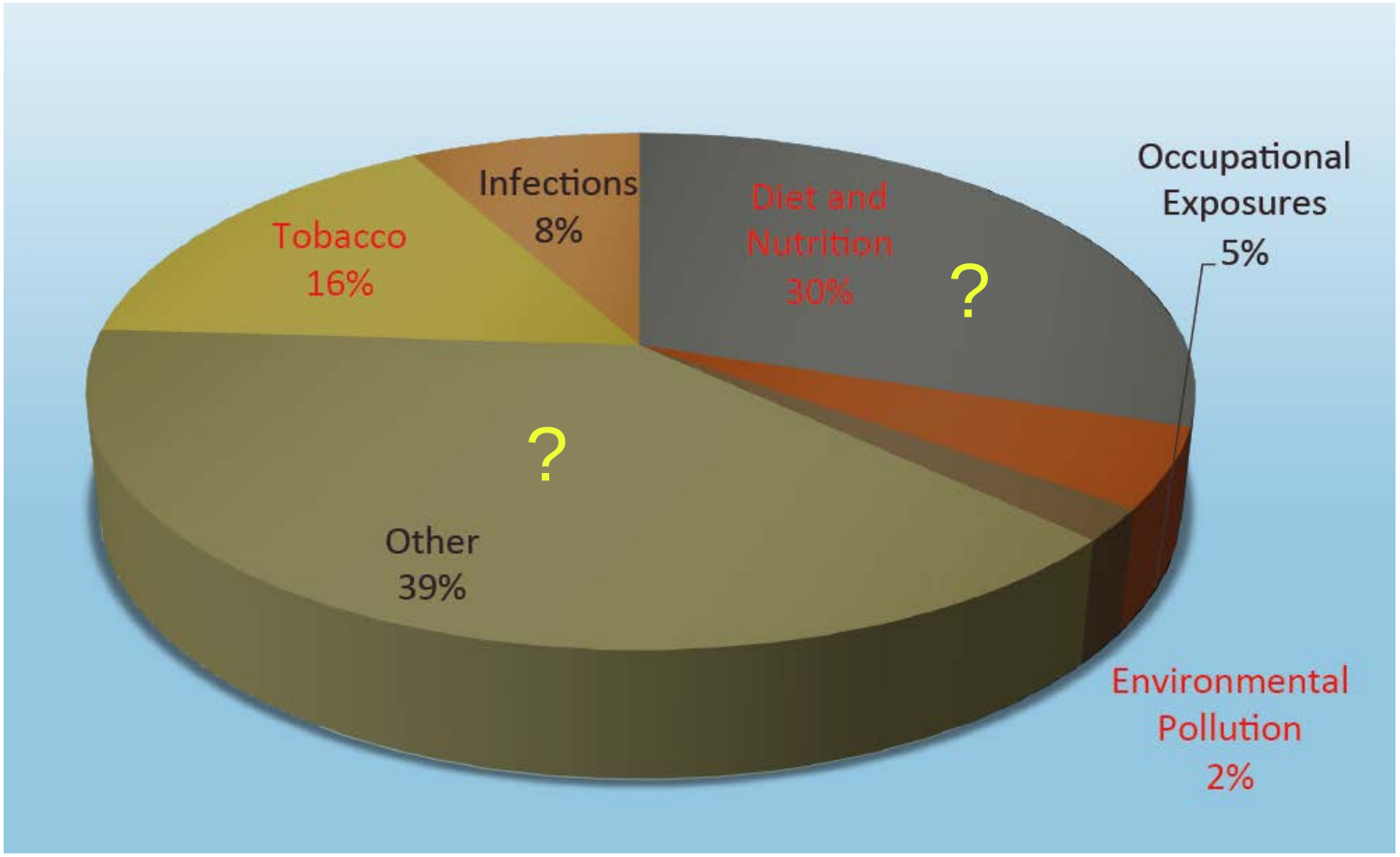
Causes for Cancer in Industrialized Countries (2006) American Cancer Society and IARC-WHO



Pesticides [66]	Chemical structure
2,4-D (H) M(g/Mol) = 221 pKa = 2.73 logP: 2.81	
Acephate (I) M(g/Mol) = 183.2 pKa = 8.35 logP: −0.85	
Acetochlor (H) M(g/Mol) = 269.8 pKa = n.a logP: 4.14	

Pesticides	Chemical structure
Aldrin (I) M(g/Mol) = 364.9 pKa = n.a logP: 6.5	
Atrazine (H) M(g/Mol) = 215.7 PKa = 4.14, 10.7 logP: −0.97	

Pesticides	Chemical structure
Bioallethrin (I) M(g/Mol) = 302.4 pKa = n.a logP: 4.68	
Bitertanol (F) M(g/Mol) = 337.4 pKa = n.a logP: 4.1	

Pesticides	Chemical structure
Carbendazim (F) M(g/Mol) = 191.2 pKa = 4.2 logP: 1.48	
Carbofuran (I)	

Int. J. Environ. Res. Public Health **2011**, *8*, 2265-2303; doi:10.3390/ijerph8062265

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International Journal of Environmental Research and Public Health

ISSN 1660-4601

www.mdpi.com/journal/ijerph

Review

Effect of Endocrine Disruptor Pesticides: A Review

Wissem Mnif [1,2], Aziza Ibn Hadj Hassine [1], Aicha Bouaziz [1], Aghleb Bartegi [3], Olivier Thomas [4] and Benoit Roig [4,*]

Pesticides	Chemical structure
Chlo… methy… M(g/M… pKa = n… logP: 4	
Cyperme… (I) M(g/Mol) = 416.3 pKa = n.a logP: 5.3	
Cyproconazole (F) M(g/Mol) = 291.8 pKa = n.a logP:3.09	

Pesticides	Chemical structure
…) = 505.2 pKa = n.a logP: 4.6	
Diazinon (I) M(g/Mol)… pKa = 2.6… logP: 3.69	
Dichlorvos (I) M(g/Mol) = 221 pKa = n.a logP: 1.9	

Pesticides	Chemical structure
Endrin (I) M(g/Mol) = 380.9 pKa = n.a logP: 3.2	
pKa = n.a logP: 3.3	

Pesticides	Chemical structure
Fenbuconazole (F) M(g/Mol) = 336.8 pKa = n.a logP: 3.79	
Fenitrothion (I) M(g/Mol) = 277.2 pKa = n.a	
logP: 4.07	
Fenvalerate (I) M(g/Mol) = 419.9 pKa = n.a logP: 5.01	

Nog geen 50% van genoemde bestrijdingsmiddelen die in het review artikel genoemd worden!

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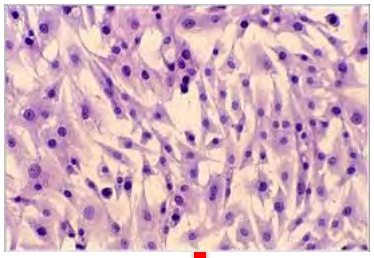
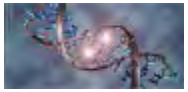
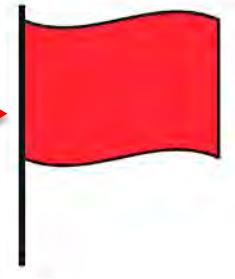
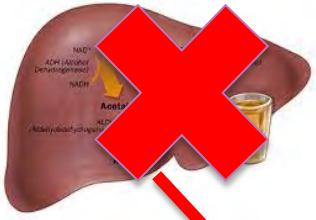


Genotoxiciteit



Endocriene
verstoring?





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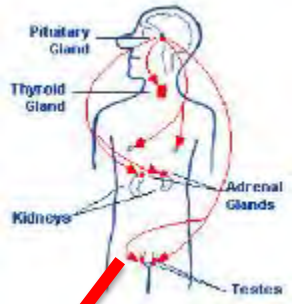

Risicoschatting

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Zwakke punten in experimentele (dier)modellen?

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Risico's van blootstelling in de vroege levensfase

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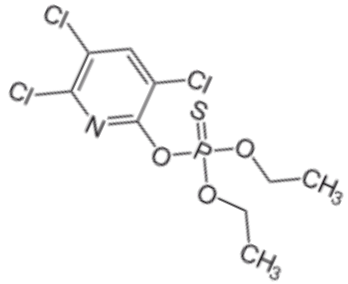
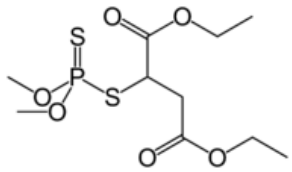
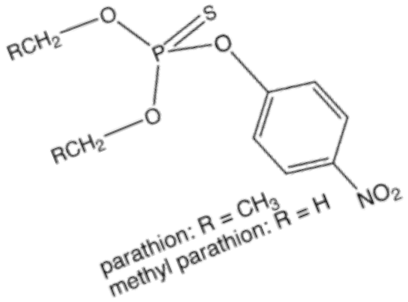
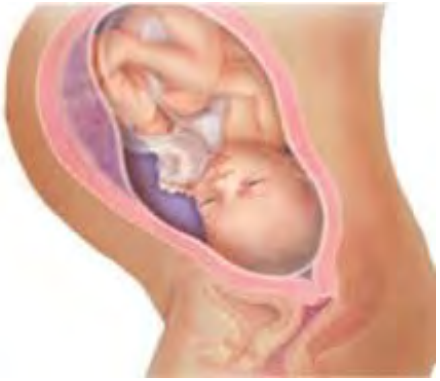






Hersen ontwikkeling en gedrag bij mens slecht te voorspellen met proefdieronderzoek



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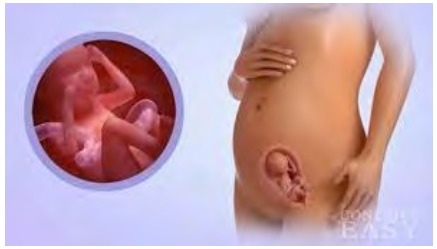
Groeiende aandacht en zorg voor socio-economische (gezondheids) efffecten



Meer aandacht voor gezondheid vs economische kosten samenleving

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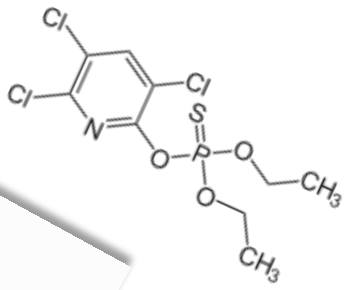
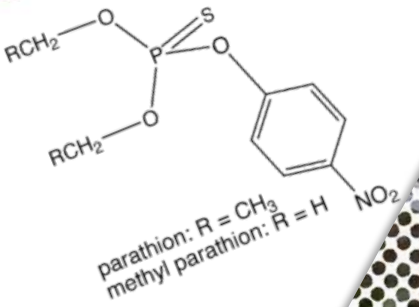
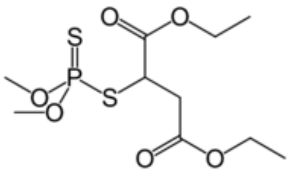
Olsson, I., Holmer, M. L., Carlsson, M., Kjäll, K., Ramböll, A. P., Niemelä, H., . . . Olsson, M. (2014). The cost of inaction-A socioeconomic analysis of costs linked to effects of endocrine disrupting substances on male reproductive health.

Rijk, I., & van den Berg, M. (June 10, 2015). ***Putting a price on your exposed brain: A case-study towards prenatal exposure to polybrominated diphenyl ethers (PBDEs), organophosphate pesticides (OPs) and associated socioeconomic cost of IQ loss In The Netherlands.*** **The Netherlands: Institute for Risk Assessment Sciences (IRAS), Utrecht University.**

Rijk, I., van Duursen M., & van den Berg, M. (2016) Health effects related to Endocrine Disrupting Chemicals and their socio-economic impact in the EU – An inventory, evaluation and way forward in cost estimates of EDC-related health effects (*in prep.).* The Netherlands: Institute for Risk Assessment Sciences (IRAS), Utrecht University.







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Institute for Risk Assessment Sciences

Putting a price on your exposed brain

A case-study towards prenatal exposure to polybrominated diphenyl ethers (PBDEs), organophosphate pesticides (OPs) and associated socio-economic cost of IQ loss in the Netherlands

Ingrid Rijk, MSc
Prof. dr. Martin van den Berg

June 2015

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Faculty of Veterinary Medicine

PEDIATRICS

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Attention-Deficit/Hyperactivity Disorder and Urinary Metabolites of Organophosphate Pesticides

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Original Contribution

Prenatal Organophosphate Metabolite and Organochlorine Levels and Performance on the Brazelton Neonatal Behavioral Assessment Scale in a Multiethnic Pregnancy Cohort

Stephanie M. Engel[1], Gertrud S. Berkowitz[1], Dana B. Barr[2], Susan L. Teitelbaum[1], Jodi Siskind[1], Stefanie J. Meisel[1], James G. Wetmur[3,4], and Mary S. Wolff[1]

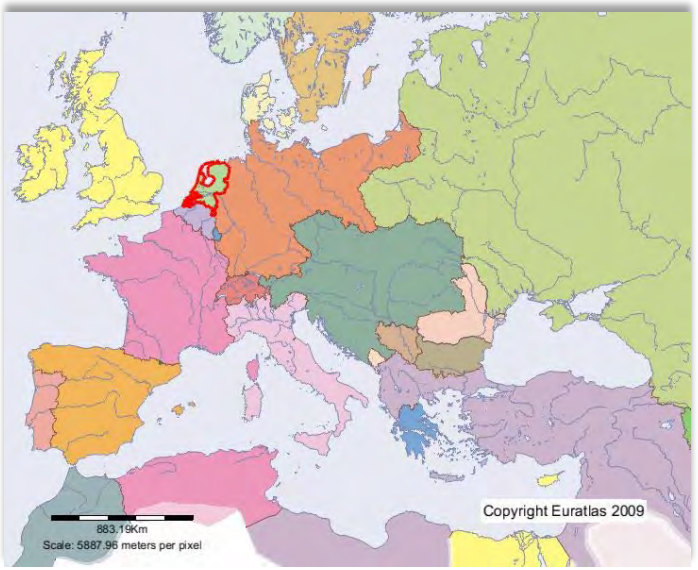

Table 6. Lost IQ points and associated socio-economic cost per year of OPs exposure for three exposure groups in the Netherlands. Calculations are based on the ERR from the CHAMACOS –study cohort (Bouchard et al., 2011)

Exposure group	Total DAP reference level (nmol/L)	IQ loss per newborn (95% C.I.)	Amount of new-borns
P50-P75	272	-1.69 (-2.72; -0.66)	42 835
P75-P95	494	-3.14 (-5.04; -1.23)	34 268
>P95	1116	-5.12 (-8.23; -2.01)	8567
Total			

Ye, X., Pierik, F. H., Hauser, R., Duty, S., Angerer, J., Park, M. M., . . . Longnecker, M. P. (2008).. *Environmental Research, 108*(2), 260-267.

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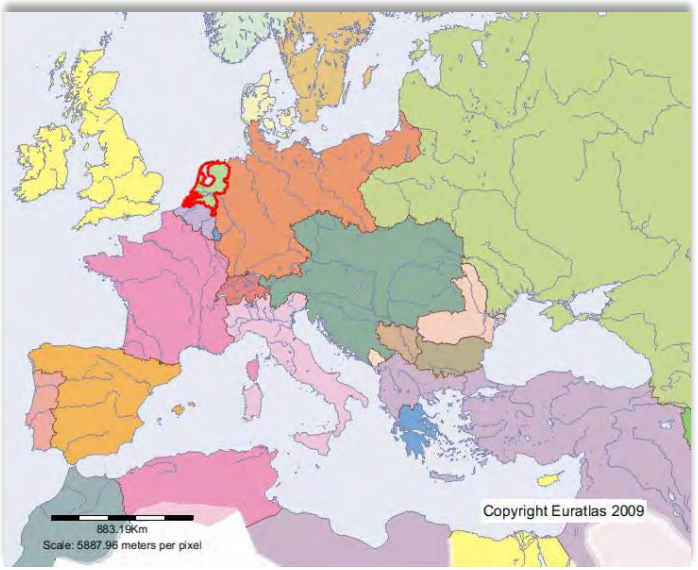

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Exposure group	Total DAP reference level (nmol/L)	IQ loss per newborn (95% C.I.	Amount of new-	IQ loss per exposure group	Socio-economic cost (95% C.I.) (million € / year of exposure)
P50-P75	272	-1.69 (-2.72; -0.66)	42 835	(-116 070, 3)	-875 (-1407; -344)
P75-P95	494	-3.14 (-5.04; -1.23)	34 268	-107 466 (-172 713; -42 219)	-1303 (-2093; -512)
>P95	1116	-5.12 (-8.23; -2.01)	8567	-43 856 (-70 483; -17229)	-532 (-854; -209)
Total				**-223 455 (-359 266; -87 821)**	**-2709 (-4354; -1064)**

1 – 4 miljard € per jaar

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Table 9. Range of EDC-attributable cost per health effect and total EDC-attributable socio-economic cost the EU (in billion €). Outliers in cost estimates and their proposed alternatives are indicated in red

Source	Nordic Council			HEAL		Trasande			This /other reports			overall range		Proposal for best range	
etiological fraction / type of estimate	2%	20%	40%	Total (2%)	Total (5%)	low	base case	high	1% / low	2,5% / base case	10% / high	lowest	highest	lowest	highest
Reproductive tract and fertility															
Reduced female fertility				0,048 - 0,062	0,120 - 0,155										
Reduced male fertility	0,007	0,072	0,145				4,71					0,007	4,71	0,007	0,155
Cryptorchidism	0,018	0,181	0,363	0,018 - 0,026	0,045 - 0,065	0,117	0,130					0,018	0,363	0,018	0,363
Hypospadias	0,009	0,089	0,178									0,009	0,178	0,009	0,178
Endometriosis									0,775	1,94	7,75	0,775	7,75	0,775	7,75
Neurobehavioral diseases and disorders															
Autism spectrum disorders (ASD)				4,52	11,3	0,080	0,199	0,399				0,080	11,3	0,080	11,3
AD(H)D				0,014	0,035	2,62	4,14	4,93				0,014	4,93	2,62	4,93
IQ loss						42,2	133,4	183,6	32,0	84,3	136	42,2	183,6	42,2	183,6
Mental retardation						6,11	22,6	33,43				6,11	33,4	6,11	33,4
Neural tube defects									0,008	0,019	0,077	0,008	0,077	0,008	0,077
Hormone-related cancers															
Breast cancer				0,320	0,800							0,320	0,800	0,320	0,800
Prostate cancer				0,180	0,450							0,180	0,450	0,180	0,450
Testis (testicular germ cell)															
Metabolic syndroms, imm															
Obesity: Obe															
Obesity adult							15,6					1,62	17,2	1,62	17,2
Diabetes mellitus (type 2)				6,0	15,0		1,44	17,2				1,44	17,2	1,44	17,2
Increment death rate among men							7,96					7,96	7,96	0,8	0,8
Asthma									0,173	0,432	1,73	0,173	1,73	0,173	1,73
TOTAL (billion €)	0,059	0,591	1,185	12,7	31,6	44,7	192,6	270,4	NA	NA	NA	60,9	292,6	56,4	280,8
TOTAL (billion €) after correction	NA			NA		157 (90% C.I. 32 – 212)			NA			NA		NA	

Geschatte directe en indirecte kosten ED effects, including biociden,
50-300 miljard € op jaarbasis voor EU28

Rijk, I., van Duursen M., & van den Berg, M. (2016) Health effects related to Endocrine Disrupting Chemicals and their socio-economic impact in the EU –An inventory, evaluation and way forward in cost estimates of EDC-related health effects (*in prep.).* The Netherlands: Institute for Risk Assessment Sciences(IRAS), Utrecht University.

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Socio-economische voordelen wegen niet altijd op tegen de nadelen vanuit gezondheidsoogpunt

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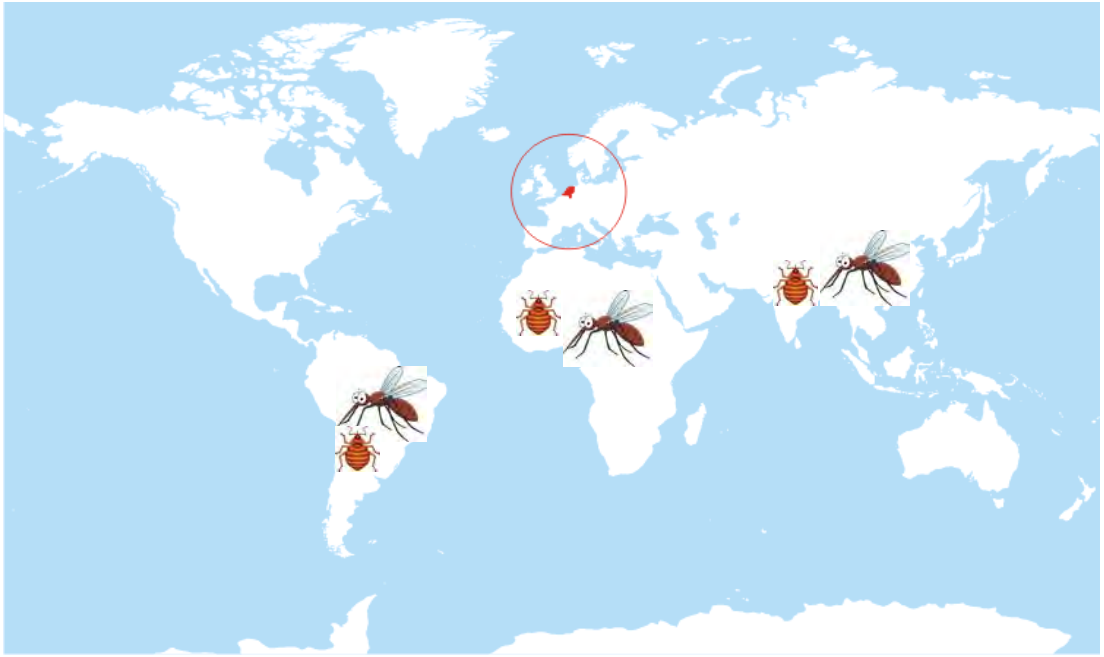
“Risico-Voordeel” analyses van biociden in mondiaal perspectief



World Health Organization

FAO FIAT PANIS

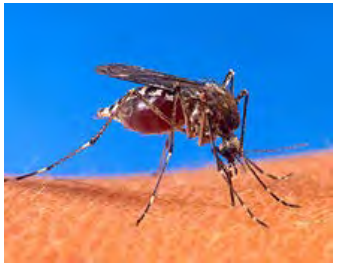
Mosquitoes:

- *Chikungunya*
- *Dengue fever*
- *Rift Valley fever*
- *Yellow fever*
- *Zika*
- *Malaria*
- *Japanese encephalitis*
- *Lymphatic filariasis*
- *West Nile fever*

Flies
Leishmaniasis
Sandfly fever
Sleeping sickness
River blindness

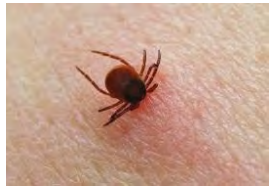
Fleas
Plague
Rickettsiosis

Ticks:
Haemorrhagic fever
Lyme disease
Relapsing fever
Spotted and Q fever)
Encephalitis
Tularaemia

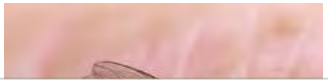


Aquatic snails
Bilharziasis

Triatomine bugs
Chagas disease



Flies



Mosquito

- *Chikun*
- *Dengu*
- *Rift Va*
- *Yellow*
- *Zika*
- *Malaria*
- *Japane*
- *Lympha*
- *West N*

World Health Organization

Every year more than 1 billion cases and over 1 million deaths from vector-borne diseases such as malaria, dengue, schistosomiasis, human African trypanosomiasis, leishmaniasis, Chagas disease, yellow fever, Japanese encephalitis and onchocerciasis, globally.

Vector-borne diseases account for over 17% of all infectious diseases.

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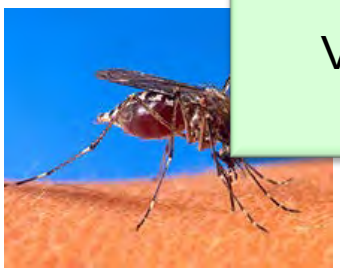
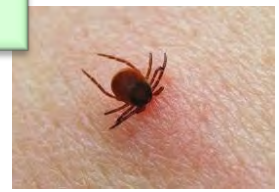


Triatomine bugs
Chagas disease



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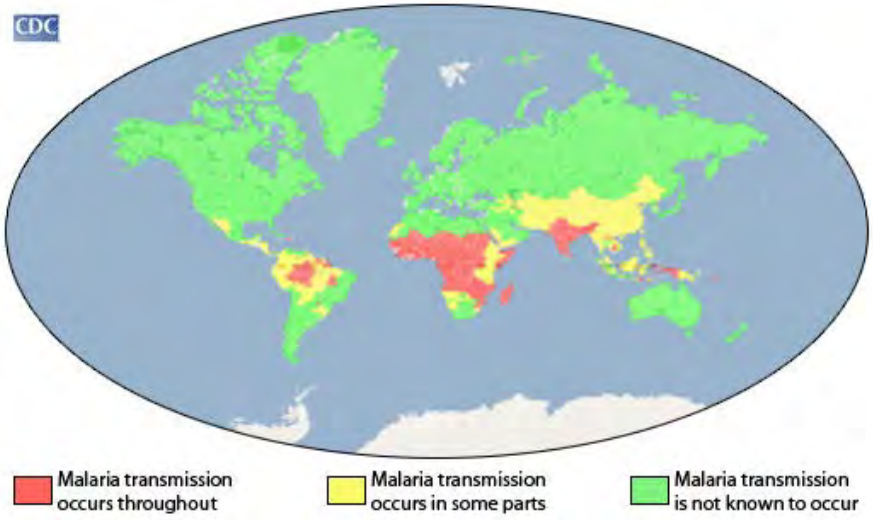

Malaria

About 40% of the world's population at risk.
Up to 500 million cases occur every year
Up to 2.7 million deaths annually.

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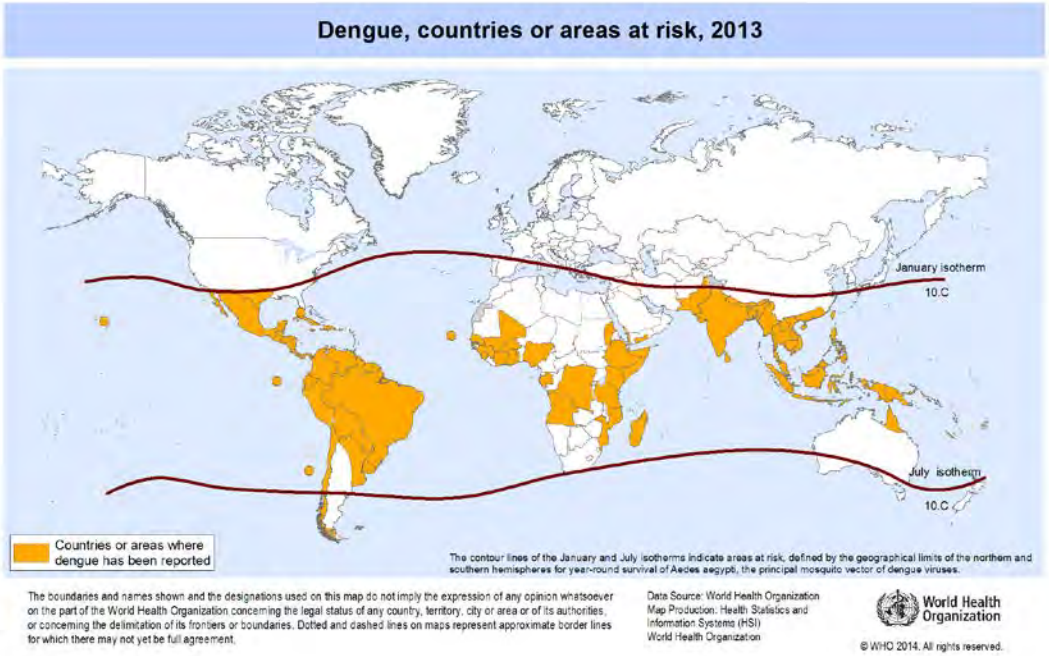
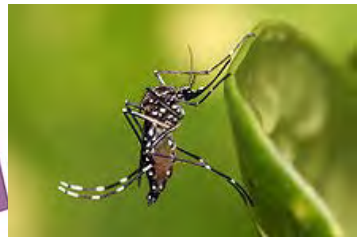
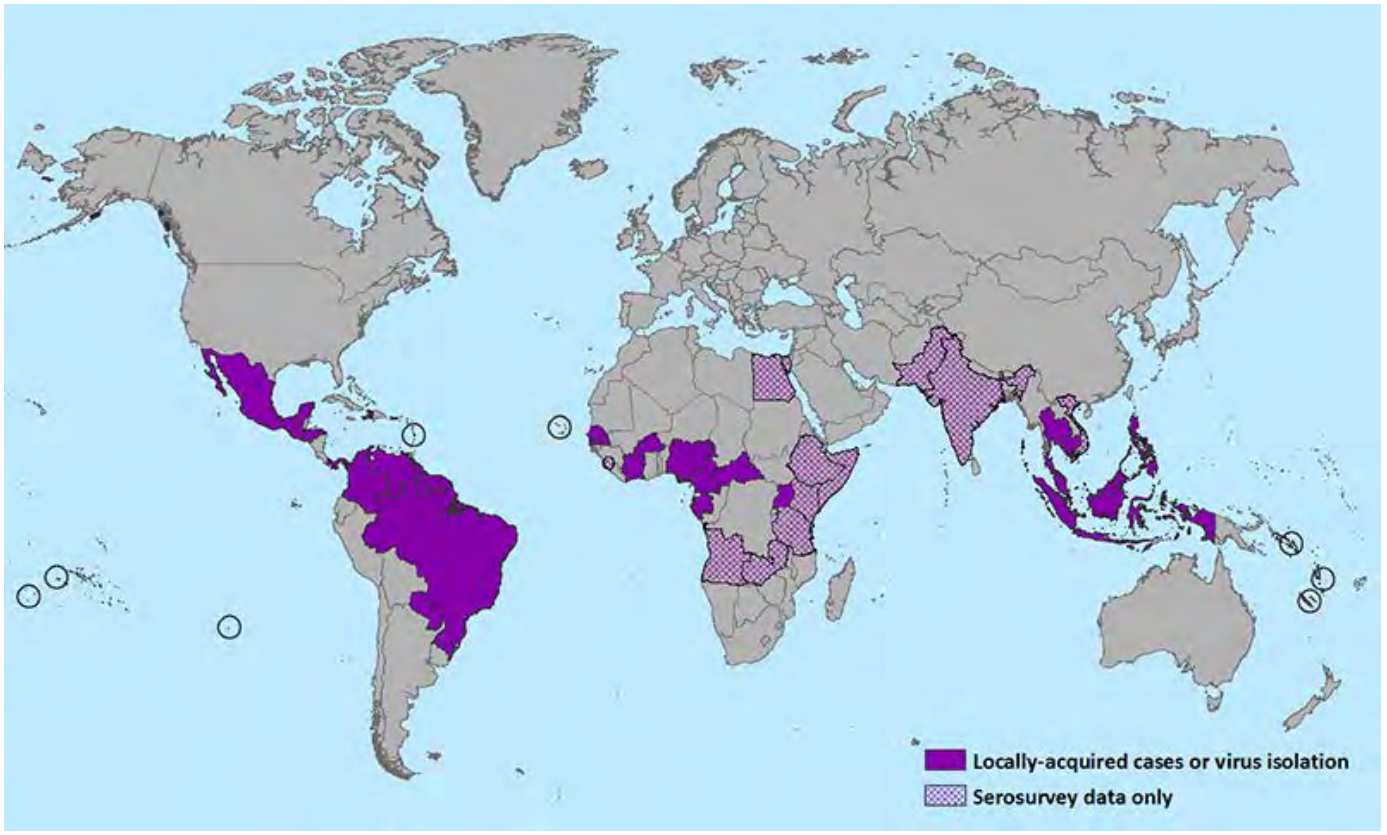


Dengue

2500 million people worldwide at risk of infection
20 million cases a year in more than 100 countries.
Tens of thousands serious dengue haemorrhagic fever.





Zika virus distribution

Symptomen vergelijkbaar met Dengue en Chikungunya

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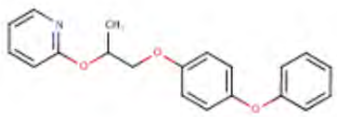
World Health Organization

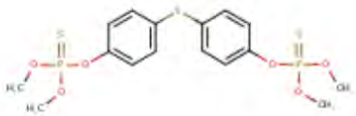
WHOPES-recommended compounds and formulations for control of mosquito larvae

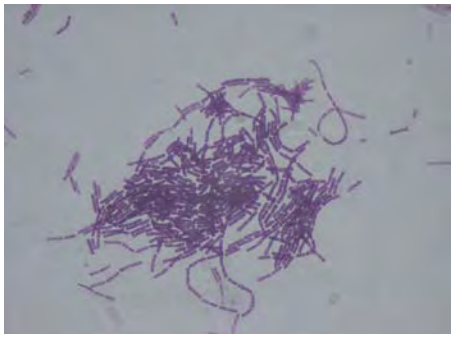
Insecticide compounds and formulation(s)[1]	Class group[2]	Dosage (active ingredient)		
		General (open water bodies)		Container-breeding (mg/L)
		(g/ha)	(mg/m^2)	
***Bacillus thuringiensis israelensis*, strain AM65-52, WG (3000 ITU/mg)**	BL	125–750[3]	12.5–75[3]	1–5[3]
***Bacillus thuringiensis israelensis*, *strain* AM65-52, GR (200 ITU/mg)**	BL	5,000–20,000[3]	500–2000[3]	-
Chlorpyrifos EC	OP	11–25	1.1–2.5	-
Diflubenzuron DT, GR, WP	BU	25–100	2.5–10	0.02–0.25
Novaluron EC	BU	10–100	1–10	0.01–0.05
Pyriproxyfen GR	JH	10–50	1–5	0.01
Fenthion EC	OP	22–112	2.2–11.2	-
Pirimiphos-methyl EC	OP	50–500	5–50	1
Temephos EC, GR	OP	56–112	5.6–11.2	1
Spinosad DT, EC, GR, SC	SP	20–500	2–50	0.1–0.5
Spinosad 83.3 monolayer DT	SP	250–500	25–50	-
Spinosad 25 extended release GR				
Open bodies of water	SP	250–400	25–40	-
Control of Culex quinquefasciatus in open bodies of water with high organic matter	SP	1000–1500	100–150	-

PYRIPROXYFEN
CASRN: 95737-68-1



TEMEPHOS
CASRN: 3383-96-8





Bacillus thuringiensis

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Binnen Europa insecten als vector voor infectie-ziekten van zeer beperkt belang.
Hoe zit het dan met risico's van biociden op groente en fruit

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Tabel 3: Controlegegevens per land van herkomst (op alfabetische volgorde) 2013-15

Land	aantal monsters	% boven wettelijke norm	middelen per monster
Argentinië	62	3,2	2,8
België	60	3,3	2,3
Brazilië	231	7,8	2,4
Chili	154	1,3	2,8
China	776	6,4	3,3 ↓
Colombia	76	11,8	2,0
Costa Rica	80	1,3	1,4
Dominicaanse Republiek	188	15,4	1,7
Duitsland	45	0,0	1,6
Egypte	455	10,3 ↑	3,4 ↓
Frankrijk	63	1,6	1,1
India	187	8,6 ↓	4,2
Israël	110	6,4	1,5 ↑
Italië	122	3,3	1,9
Kenya	1686	4,9 ↓	1,4 ↓
Marokko	201	3,5 ↓	2,0 ↑
Mexico	55	1,8	1,8
Nederland	1346	2,2 ↑	1,3 ↑
Onbekend	55	1,8	0,9
Peru	510	2,9	3,5 ↑
Spanje	727	2,5	2,1 ↑
Suriname	98	15,3	1,1
Thailand	139	17,3	1,4
Turkije	80	7,5	3,3
Verenigde Staten	48	2,1	1,6
Vietnam	100	30,0	2,4
Zuid Afrika	353	3,7 ↑	
Genoemde landen	7962	5,4	
totaal	8389	5,7	

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Ministerie van Economische Zaken

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Biociden op groente en fruit : *Een Risico?*

- Meeste overschrijdingen van buiten de EU (ca 3%)
- Eenmalige overschrijding in voedsel minimaal risico
- Risico zit in chronische overschrijding
- Kwetsbaarste groepen zwangere vrouwen, kinderen

- Biologische producten geen meerwaarde voor algemene volksgezondheid (perceptie) vanuit biociden oogpunt
- Meerwaarde is minder biociden in milieu en daardoor minder impact op biodiversiteit

Nederlandse Voedsel- en Warenautoriteit
Ministerie van Economische Zaken

Risico's biociden van uit **humaan** toxicologisch perspectief

- Moderne biociden *onmisbaar voor bestrijding door insect-overdraagbare ziekten*.
- "Risico-voordeel" principe *zonder meer aan de voordeel kant* bij insect-overdraagbare ziekten

- *Risico's biociden* op groente en fruit voor *merendeel niet of minimaal*, (wel voor veelvuldige blootstelling boven de norm gezondheidsrisico en kwetsbare groepen)

- De *risico-percepti* n fruit over het algemeen *hoger dan de feite*

Grootste onzekerheid!

maar……

- *Huidige testmethoden* risicos tijdens zwangerschap en eerste levensjaren vrijwel zeker te *simpel* en hebben maar *beperkte voorspellende waarde*

Risico's biociden van uit **eco**-toxicologisch perspectief

- Moderne biociden nog steeds impact op "non-target" organismen.
- Moderne biociden, in combinatie met monoculturen, kunnen een significante impact op biodiversiteit en ecosystemen hebben.
- In Nederland en EU landen de "luxe" om ons te bekommeren over eco-effecten. Grootste deel wereldbevolking heeft deze "luxe" niet door voedselschaarste, natuurrampen, klimaat etc.
- Rijke landen (w.o. NL) voortouw nemen in ontwikkeling ecologisch en ecotoxicologisch verantwoorde landbouw productie-methoden, die uiteindelijke ook toepasbaar zijn in andere delen van de wereld.

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Dank voor uw aandacht