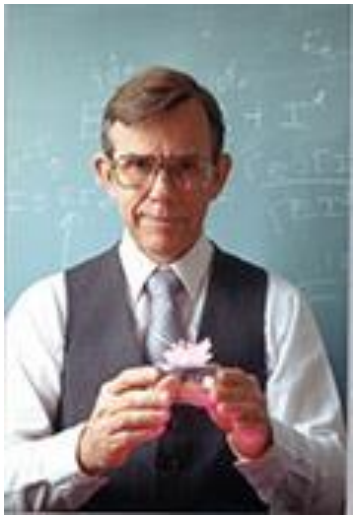
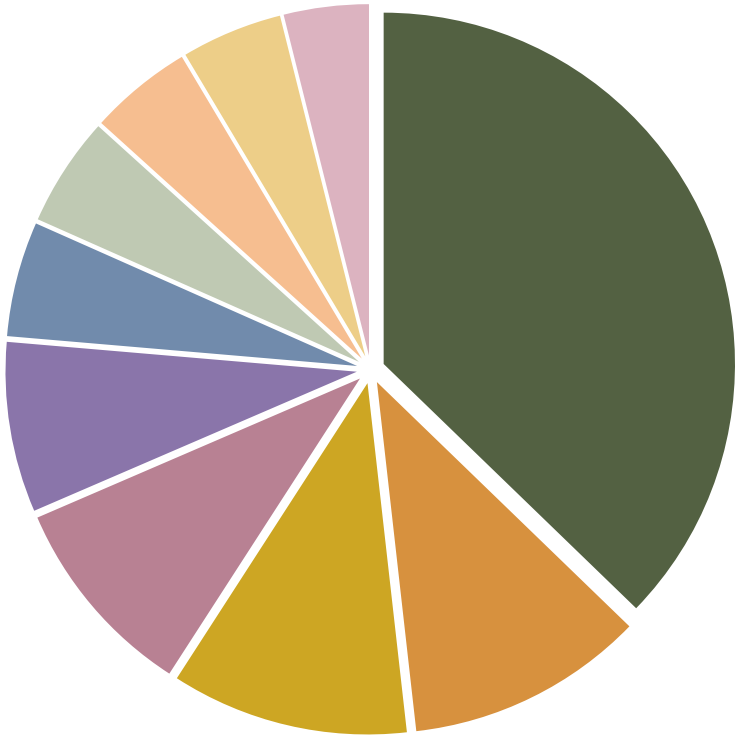
EXPOSURE TO GLYPHOSATE: SHOULD WE WORRY?

Sílvia Lacorte

Department of Environmental Chemistry, IDAEA-CSIC, Barcelona



Top 10 pesticides by usage in Spain (out of 350)

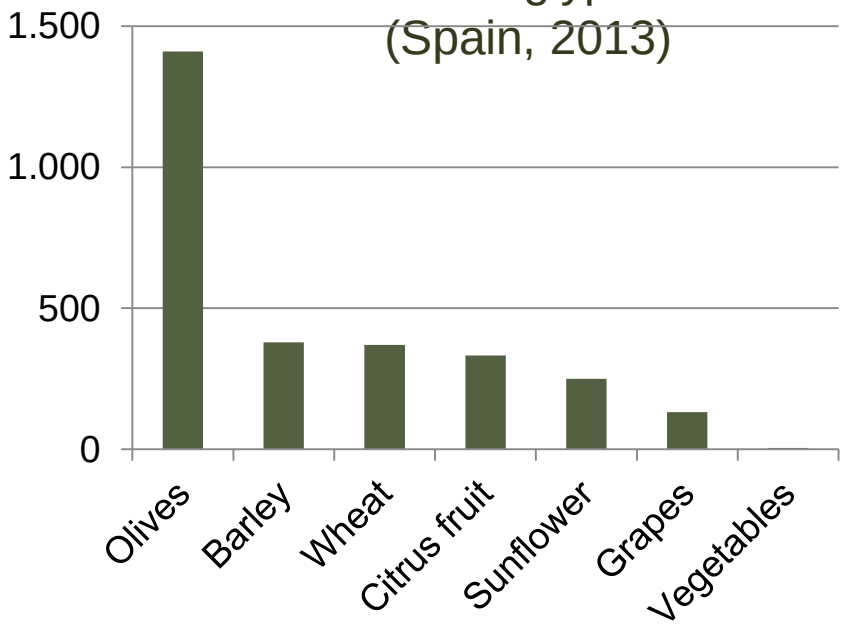


- Glyphosate
- Metam sodium
- Mancozeb
- Chlorpyriphos
- 2,4-D
- Dimethoate
- MCPA
- Fosetil-al
- Isoproturon
- Oxifluorfen

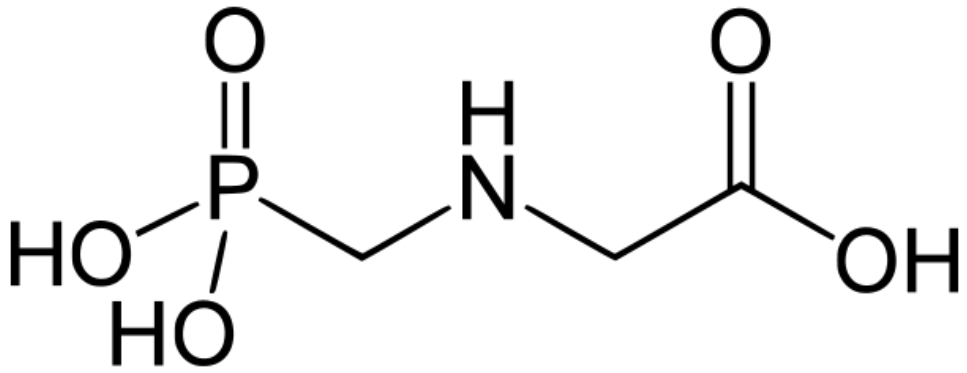
11% treated area in Spain

Total consumption: 2,880 tonnes
4,941-3,303,816 ha treated

Tonnes of glyphosate (Spain, 2013)



Glyphosate



Formulation: more than 130 formulations

Active ingredient: from 0.7% for domestic use to 68% for agriculture

Application: more than 60 types of crops

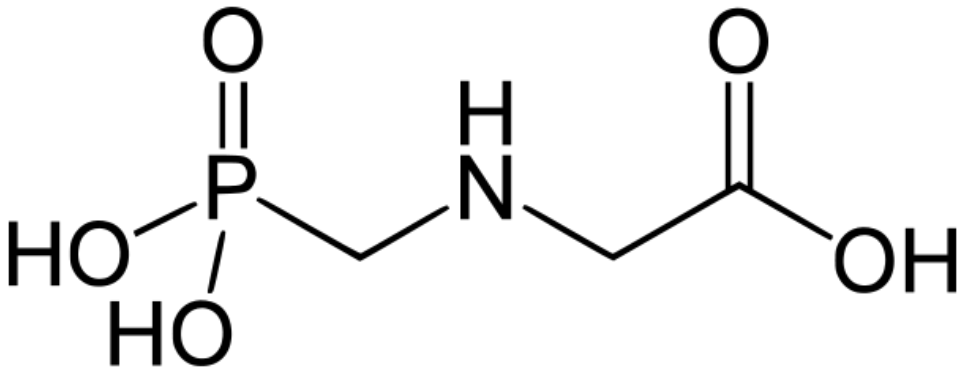
Amount applied: 0.59-1.49 kg/ha, 1 or 2 times/year

Action mode: systemic pesticide, resistance identified

ECHA: High production chemical

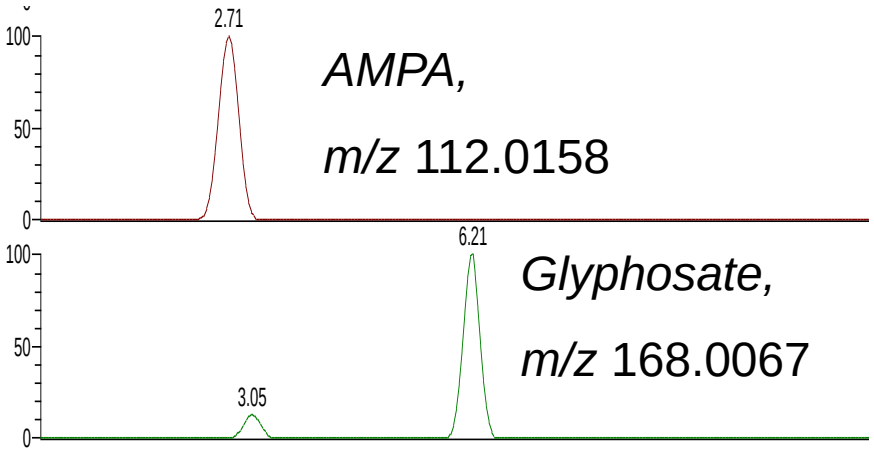
Legislation: Reg. EC 1107/2009 until 31/12/2017

Glyphosate



	Glyph	AMPA
Solubility (g L^{-1})	10.5	> 100
VP (mPa)	0.0131	0.0231
Kd (mL g^{-1})	5-900	15-1554
GUS	-0.25	0.03
DT50 soil (d)	15	121
DT50 water (d)	74	132
BCF (L kg^{-1})	0.5	-

Trace level analytical determination



Le Fur et al., 2000. Analyst 28;
Hanke et al., 2008. anal. Bioana.Chem 391

Analytical problems

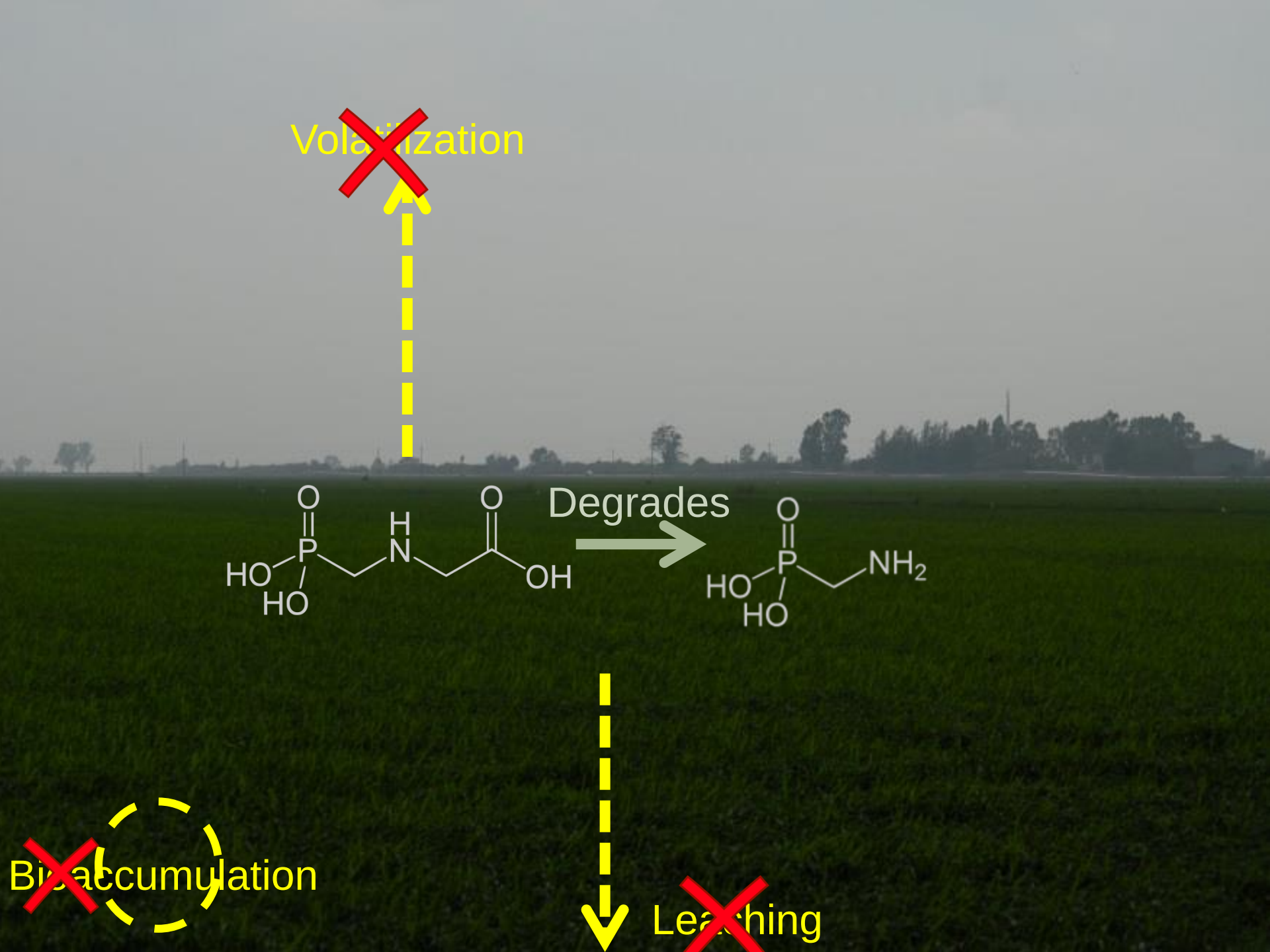
- Extraction difficulties
- Sensitivity
- Time consuming methods
- Complex instrumentation

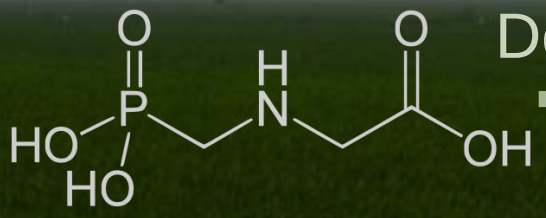
High cost

→ Reliability of results
Not many studies...

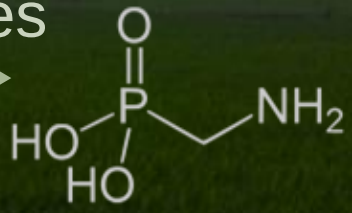
Use patterns and fate

- Formulation
- Doses
- Application period


Volatilization
Degrades
Bioaccumulation
Leaching



Degrades



Sorb to soil and may accumulate in crops

Run-off to surface waters

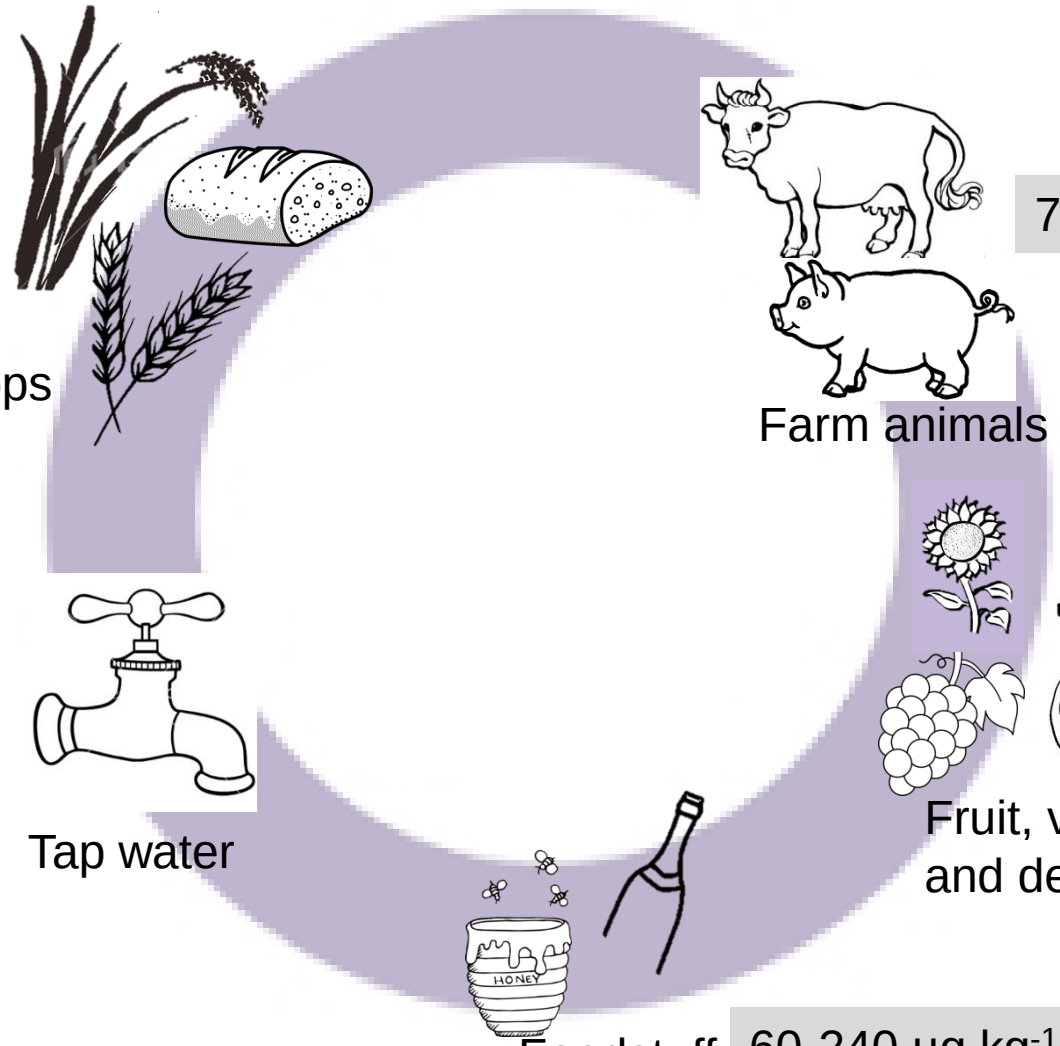
Waters

European Drinking Water Directive 98/83/EC prescribes maximum admissible concentrations of 0.1 µg L^{-1}, but this level does not reflect ecological or human toxicity)

Europe	Sites	Sample	%< 0.1	%> 0.1	µg L^{-1}
Surface waters					
Glyph.	3716	50805	29	23	0.03-427
AMPA	2728	33612	50	45	
Groundwater					
Glyph.	8925	36298	1.3	0.7	0.02-4.8
AMPA	7678	27254	1.7	0.9	

European Glyphosate Environmental Information Source, http://www.egeis-toolbox.org/
Battaglin et al, 2014, JAWRA, 50
Padilla-Sanchez et al., 2012, J. Mass Spectrom. 47, 1458

Food



12% samples
0.2-2.3 mg kg^{-1}

Crops

7-12000 µg kg^{-1}

Farm animals

7-12000 µg L^{-1}

Tap water

Few studies (n=635), 12% of samples, low residues

Fruit, vegetable and derivatives

Foodstuff

60-240 µg kg^{-1}

Bohn T, et al. (2014) Food Chem 153, 207.
Krüger M, et al. (2014) J Environ Anal Toxicol 4, 230.
Rubio F, et al. (2014). J Environ Anal Toxicol 4, 249.
Myers, 2016. Environ. Health 15.
levelshttp://www.glyphosate.eu/database/fact-sheet

Maximum Residue Levels (Reg. EU No 293/2013

	mg kg^{-1}
Citrus	0.1-0.5
Tree nuts	0.1
Pome & stone fruits	0.1
Berries	0.1-0.5
Miscellaneous fruits	0.1
Vegetables, fresh, frozen	0.1-3
Brassica	0.1
Leaf vegetables	0.1
Legumes	0.1
Fungi	0.1-50
Pulses	2-10
Oilseeds and oil fruit	0.1-20
Cereals	0.1-20
Teas and infusions	0.1-20
Species	0.1
Meats	0.05

Exposure ($mg\,kg^{-1}\,bw\,d^{-1}$)

$$EDI = \frac{\sum Fi\ x\ Ci}{bw} = \frac{0.6\ mg}{60\ kg} = 0.01$$

$$ADI = \frac{\sum Fi\ x\ Ci}{bw}$$

0.3 EU
0.5 EFSA
1.75 USA

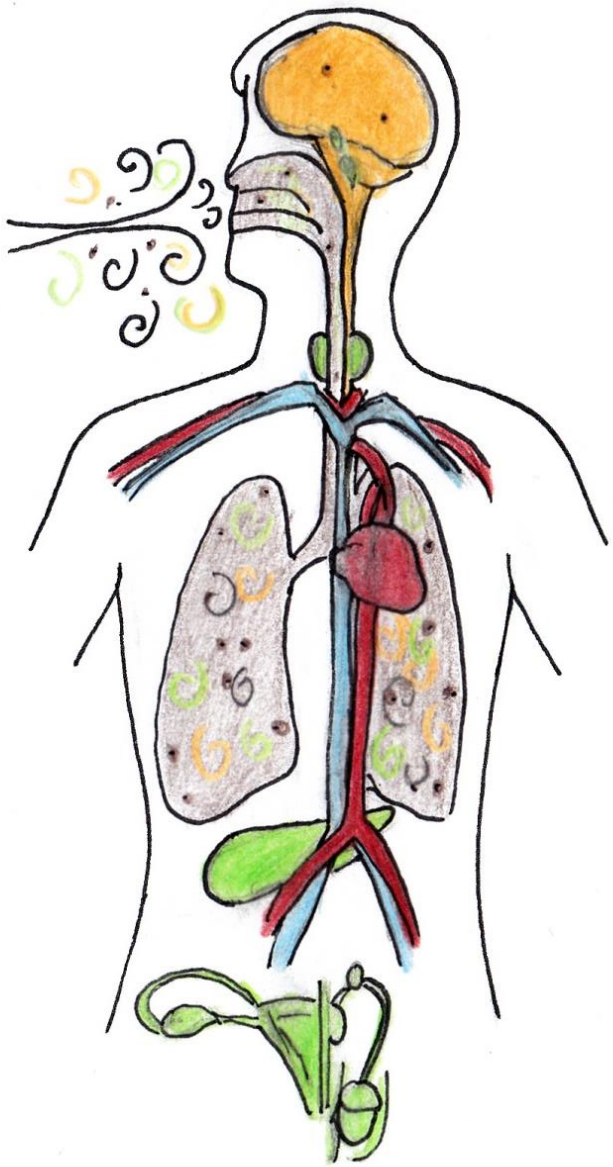
$$\%\ ADI = \frac{0.01\ x\ 100}{0.3} = 3.3\%$$

Effects

Reg. (EU) No 293/2013, ec.europa.eu/environment/archives/.../ma_reding_annex4.pdf

Impact on human health

Glyphosate	AMPA
Toxicity 2000 mg/kg rat	8300 mg/kg rat
Skin irritant	Tract irritant
Eye irritant	Skin sensitizer
Potentail carcinogen	Eye irritant
Potential EDC	Phototoxicant
	Probable liver and kidney toxicant



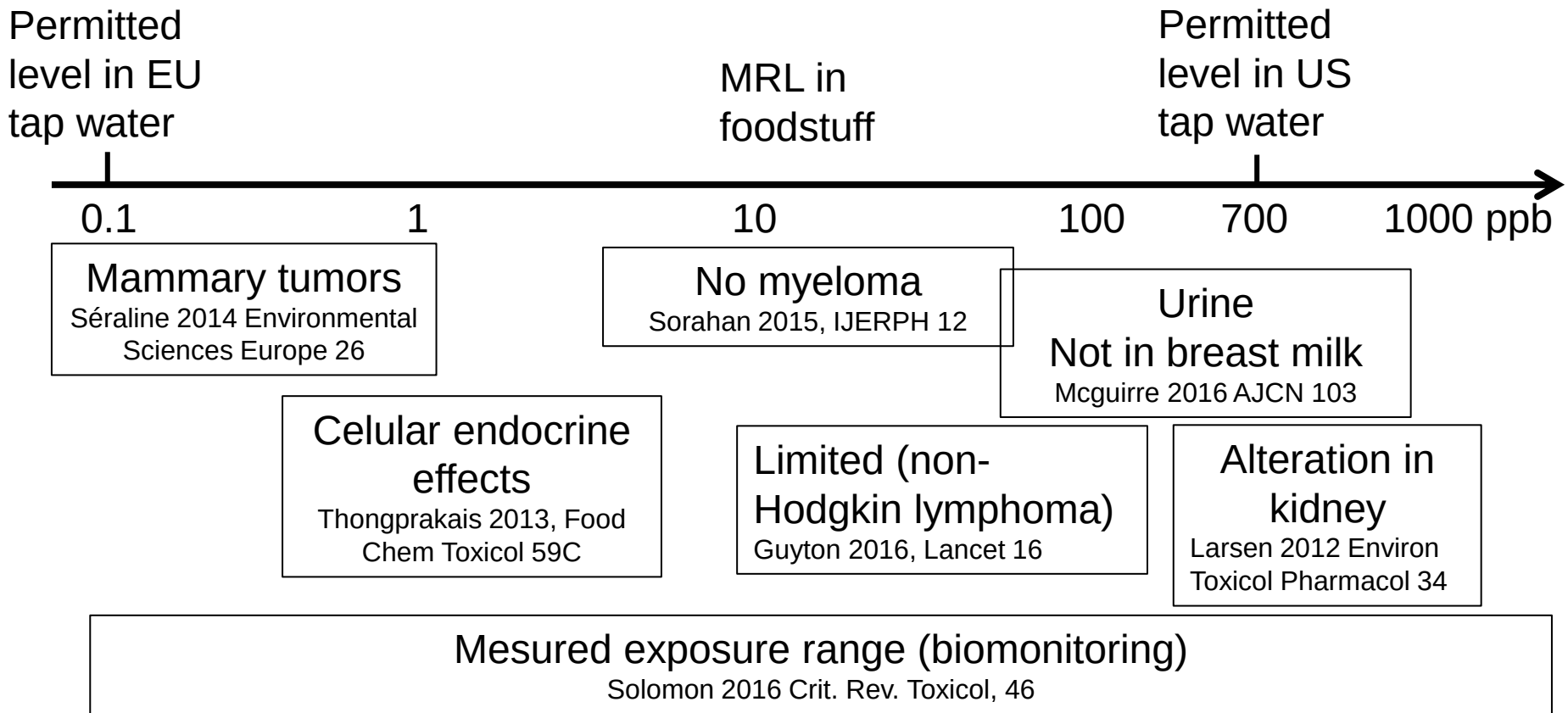
Risk?

- Dose
- Frequency of exposure
- Vulnerability
- Formulation

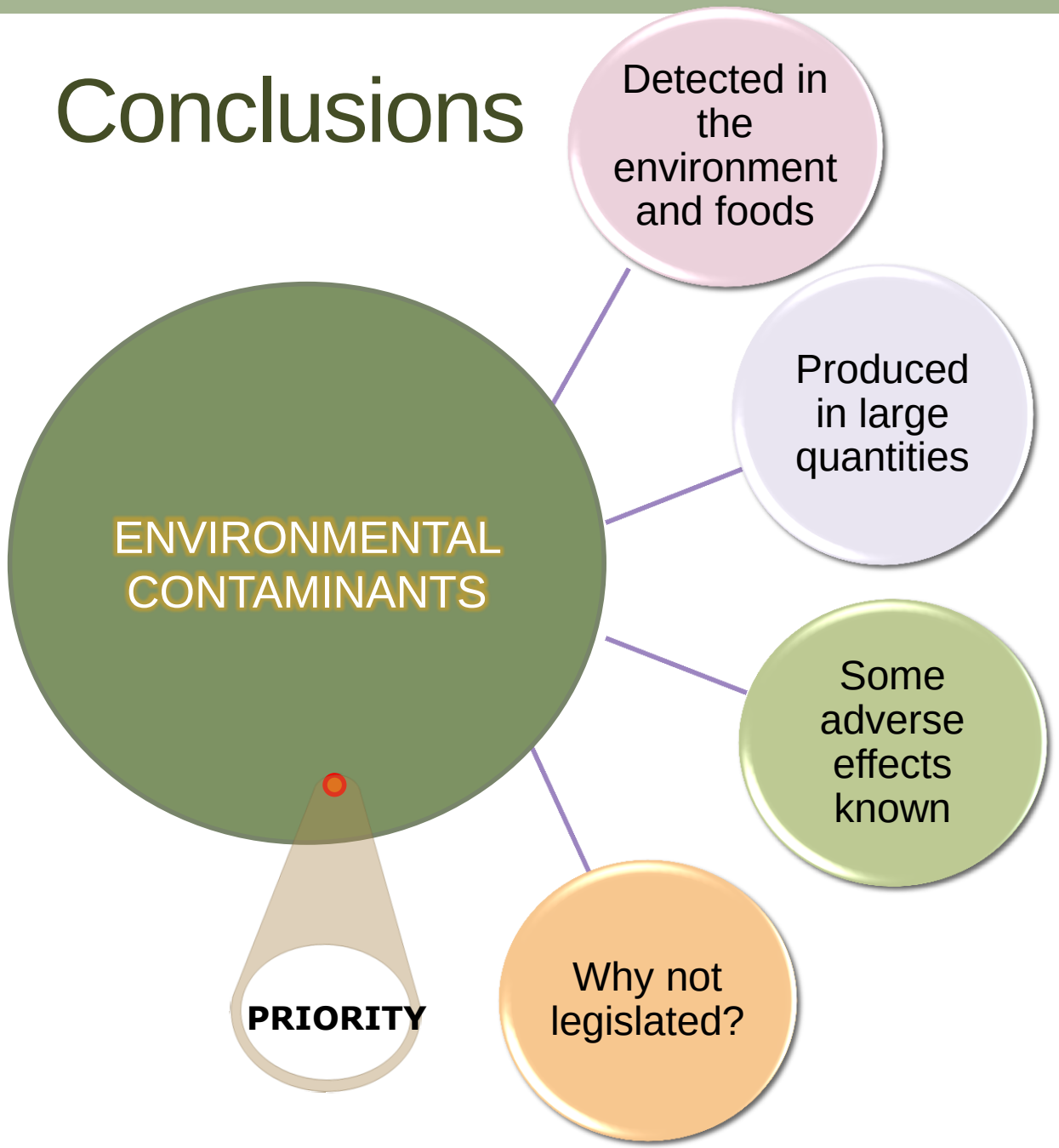
Richard et al., (2005) EHP 113

Effects in humans

Toxicological endpoints at **low concentration level**: estrogenicity, genotoxicity, oxidative stress, reproduction, neurologic, metabolism, behaviour, etc.



Conclusions



NEEDS

- Analytical: ensure reliability of the results for waters and soil: intercomparison studies.
- Environmental: higher sampling frequency required to provide a conclusive picture of pesticide occurrence
- Food: far more food quality control analysis
- Toxicity: identification of toxicological endpoints at low concentration level

Thank you for your attention