



41st
congress
APImondia 2009
15-20 SEPTEMBER • MONTPELLIER - FRANCE
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Imidacloprid contaminates the pollen of seed-coated crops : A high risk for bees

BEE HEATH COMMISSION - PLENARY SESSION

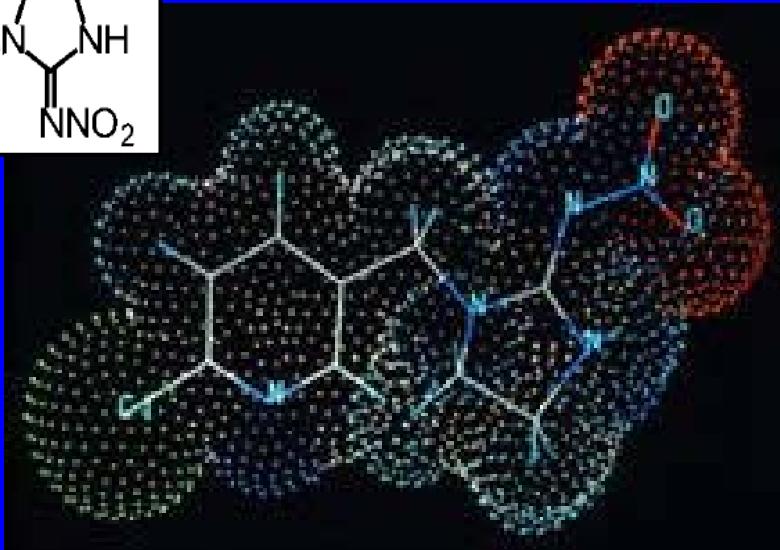
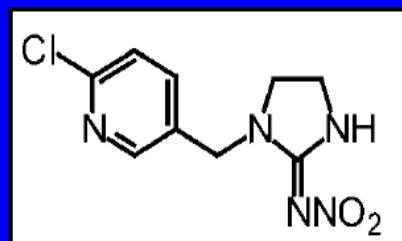
“Has beekeeping a future : new challenges or bee health”

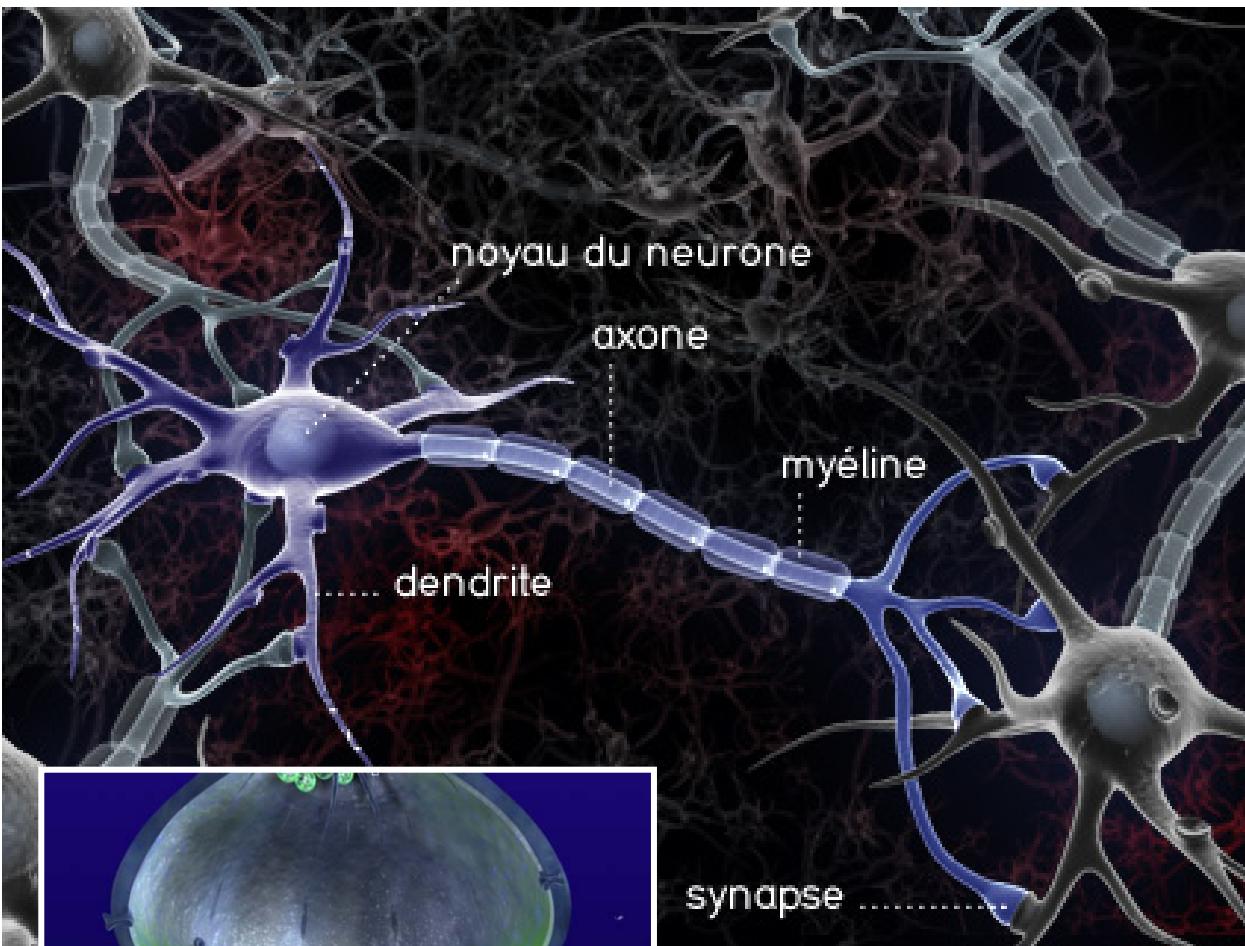
Friday 18th afternoon

Chair : Wolfgang RITTER

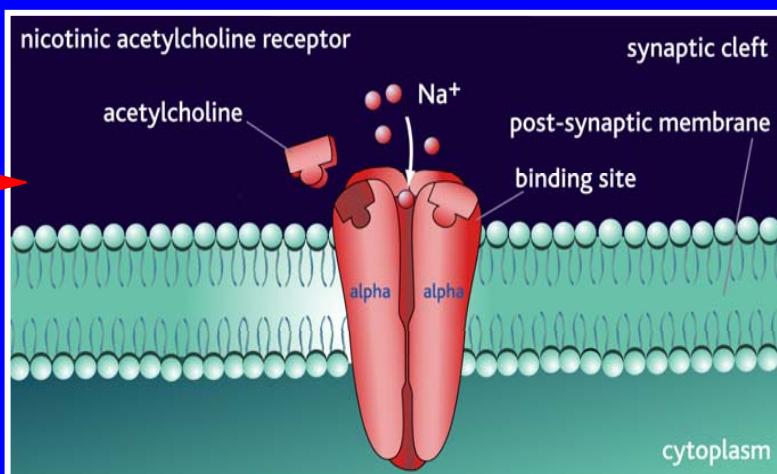
Dr J-M. BONMATIN, Centre de Biophysique Moléculaire, CNRS Orléans, France

Honeybees & imidacloprid





Dr. JM Bonmatin (CNRS) France



Commercial :

*Gaucho, Confidor, Férial
Advantage, Provado, etc.*

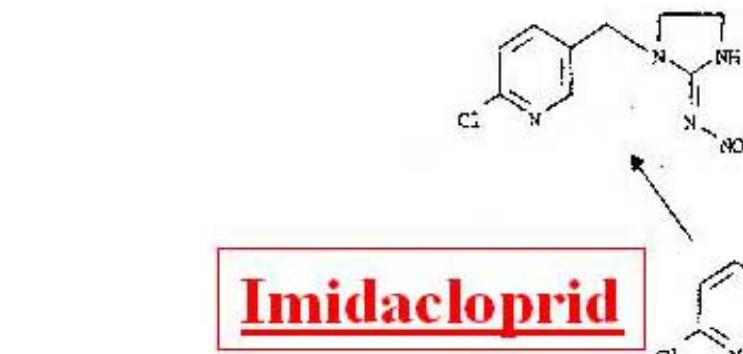
France :

Gaucho	1994
suspended /sunflower	1999
suspended /maize	2004

Doses ~ 50 à 100 g/ha

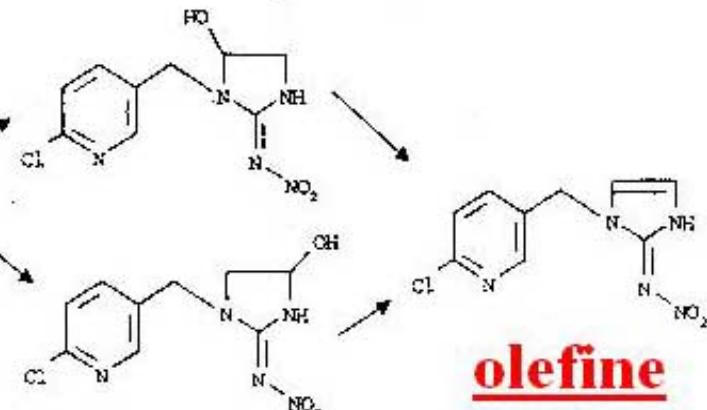
All derivatives then lead to the toxic 6-chloronicotinic acid

nitroso



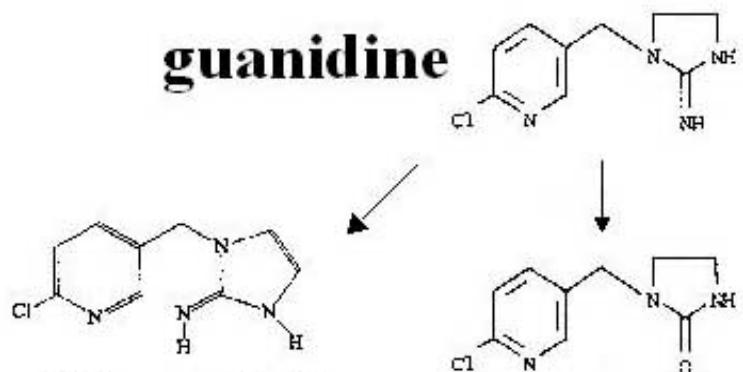
Imidacloprid

monohydroxy (x 2)



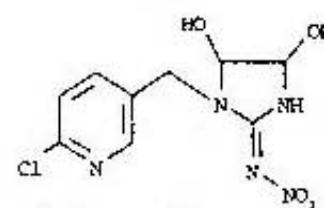
olefine

guanidine



guanidine-olefine

urea

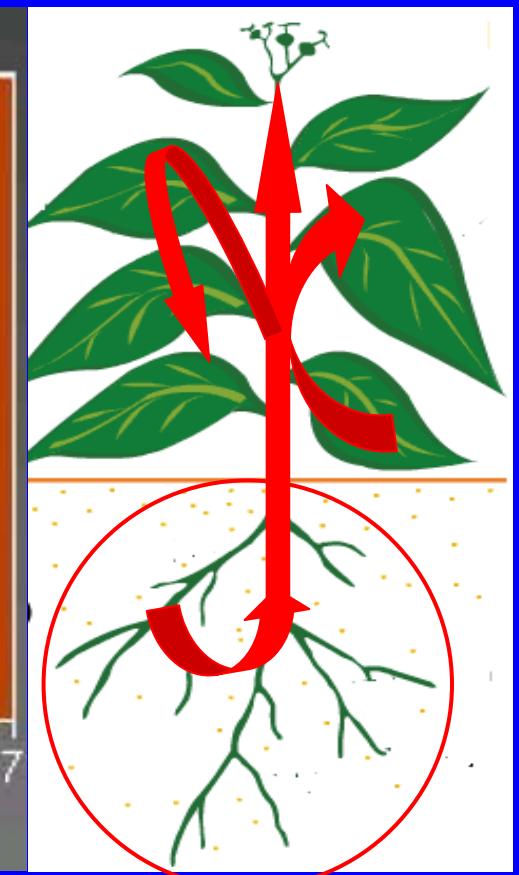
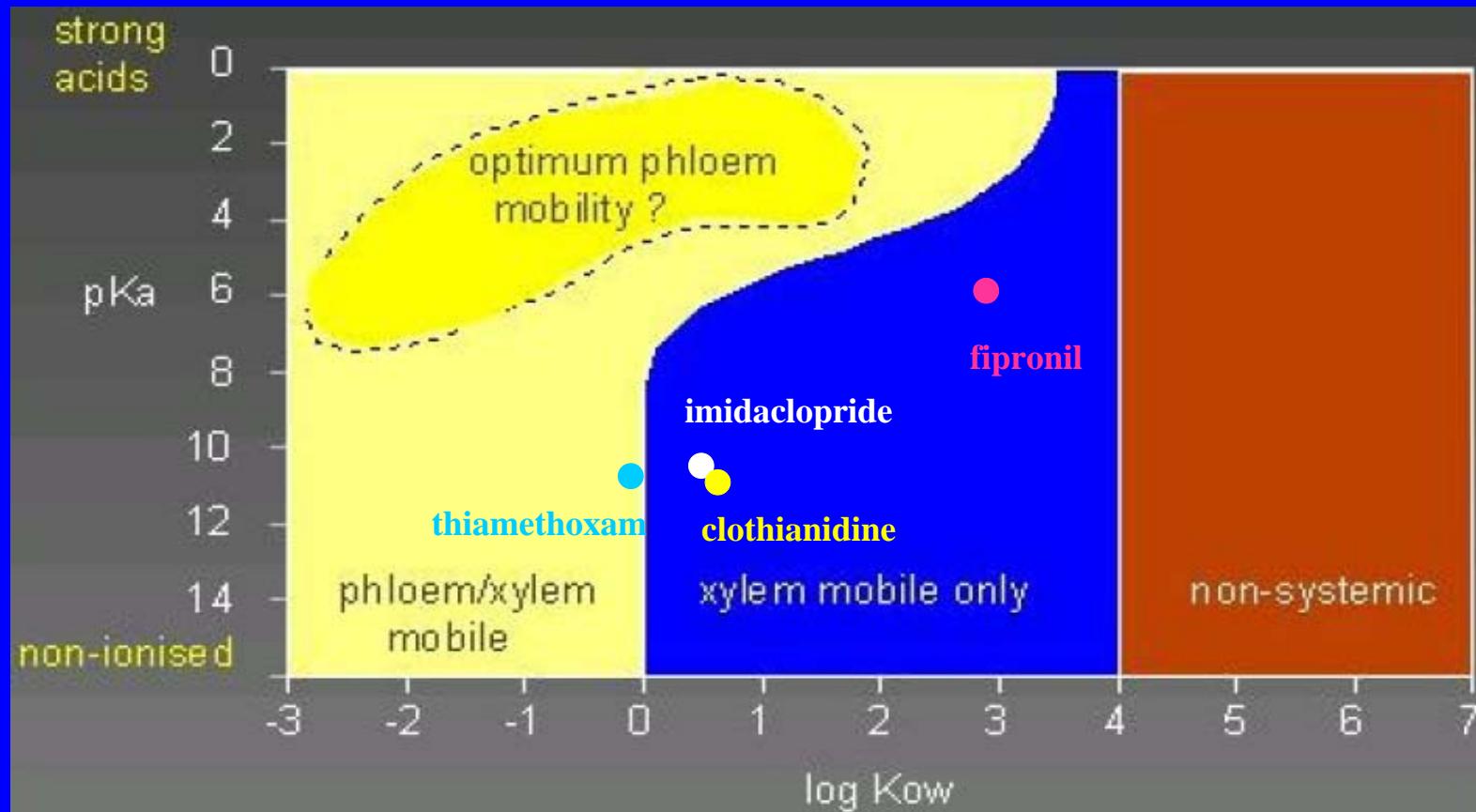


dihydroxy

Nauen et al., Pestic. Sci. 1998

Oliveira et al., J. Environ. Sci. Health 2000

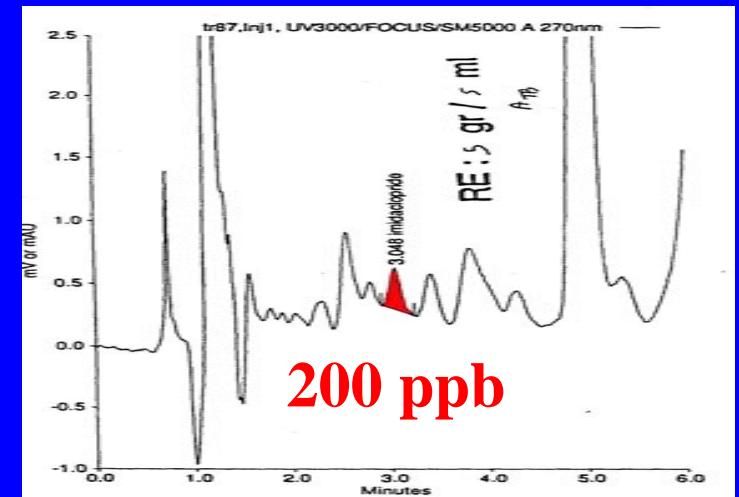
Systemic Insecticides : Xylemic and phloemic transport



Bromilow, R.H., Chamberlain, K. & Evans, A.A. (1990) *Weed Science*, 38, 305-314.

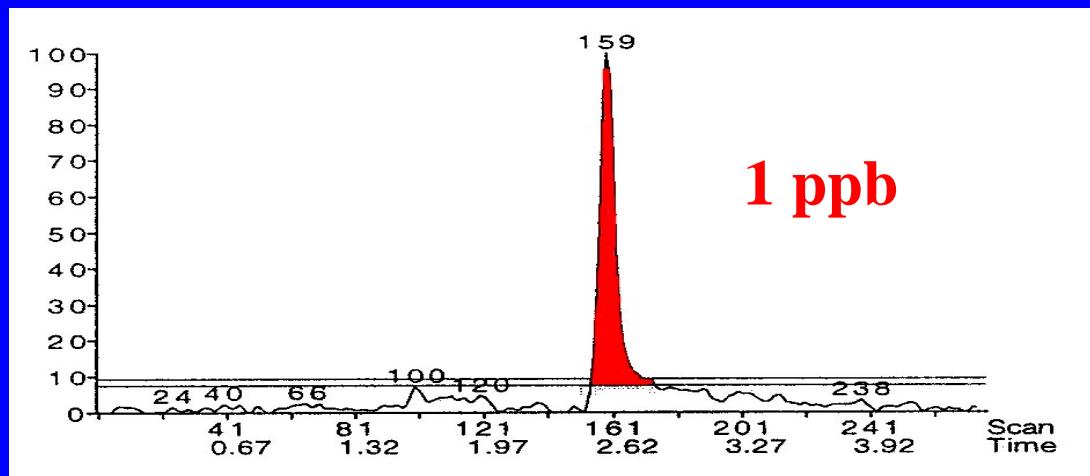
Analytics

- BAYER 1993
HPLC/UV

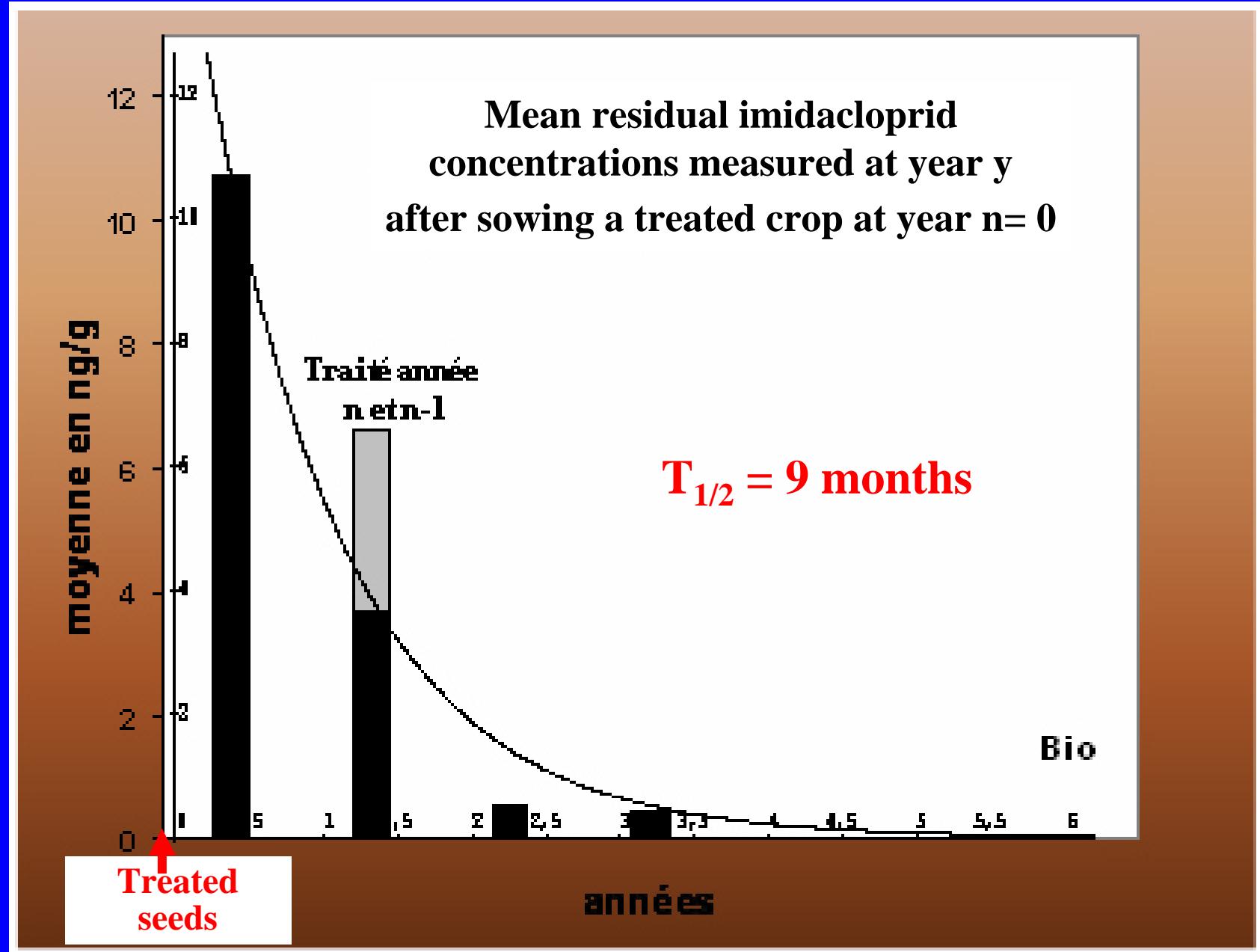


- CNRS 2003
HPLC/MS/MS + Directive 96/23 CE, GLP, QC

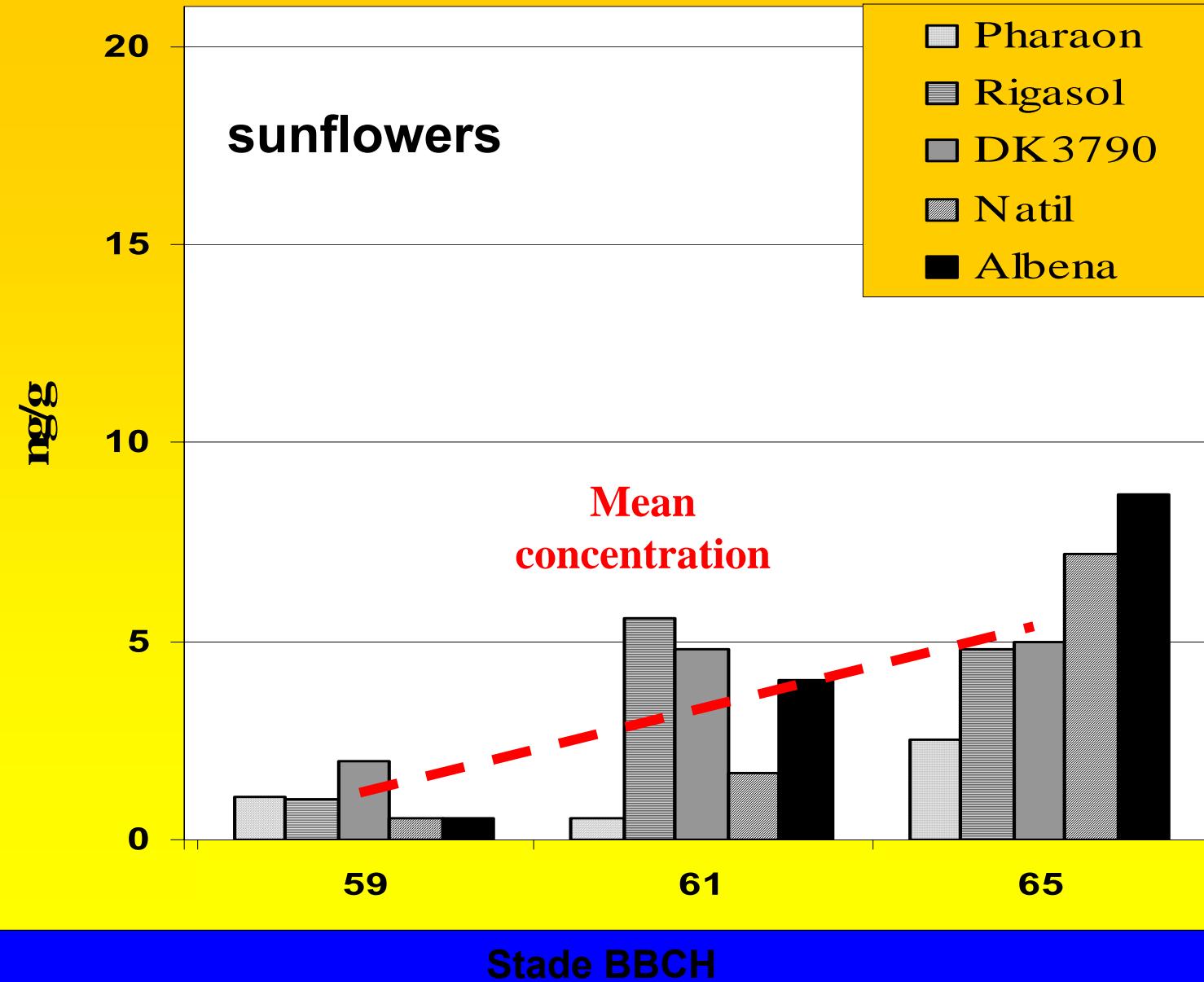
LOD = 0.1 ppb
LOQ = 1 ppb

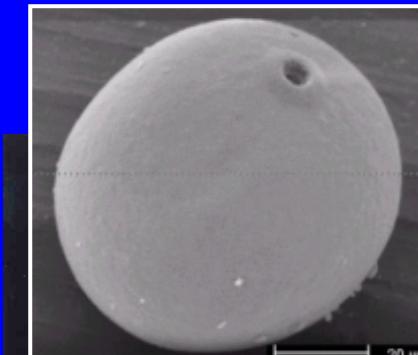
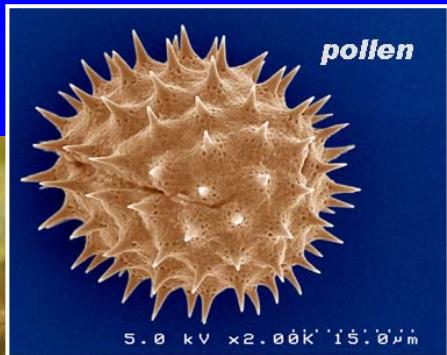


Remains in soils after harvesting (sunflower)

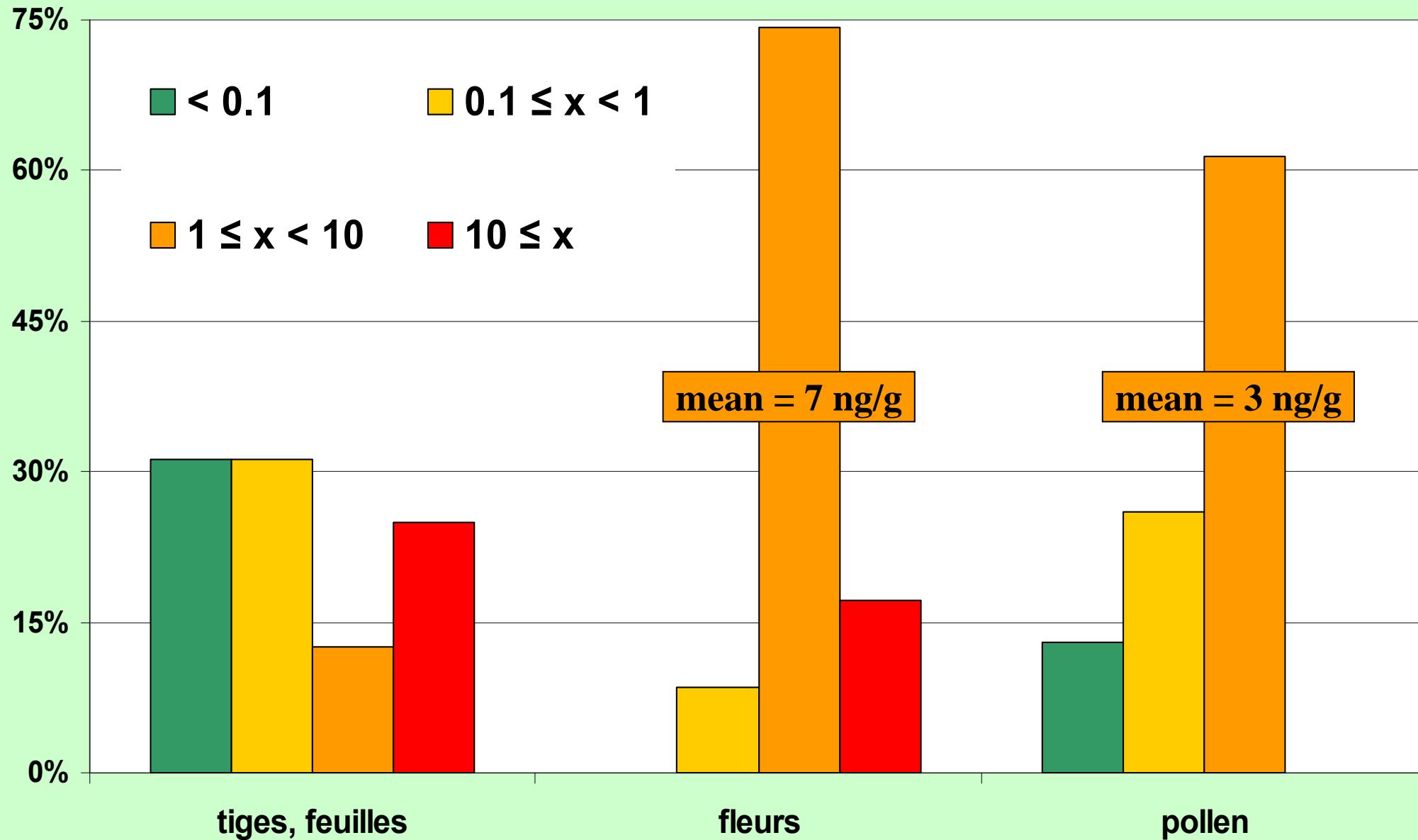


Imidacloprid uptake in flowers



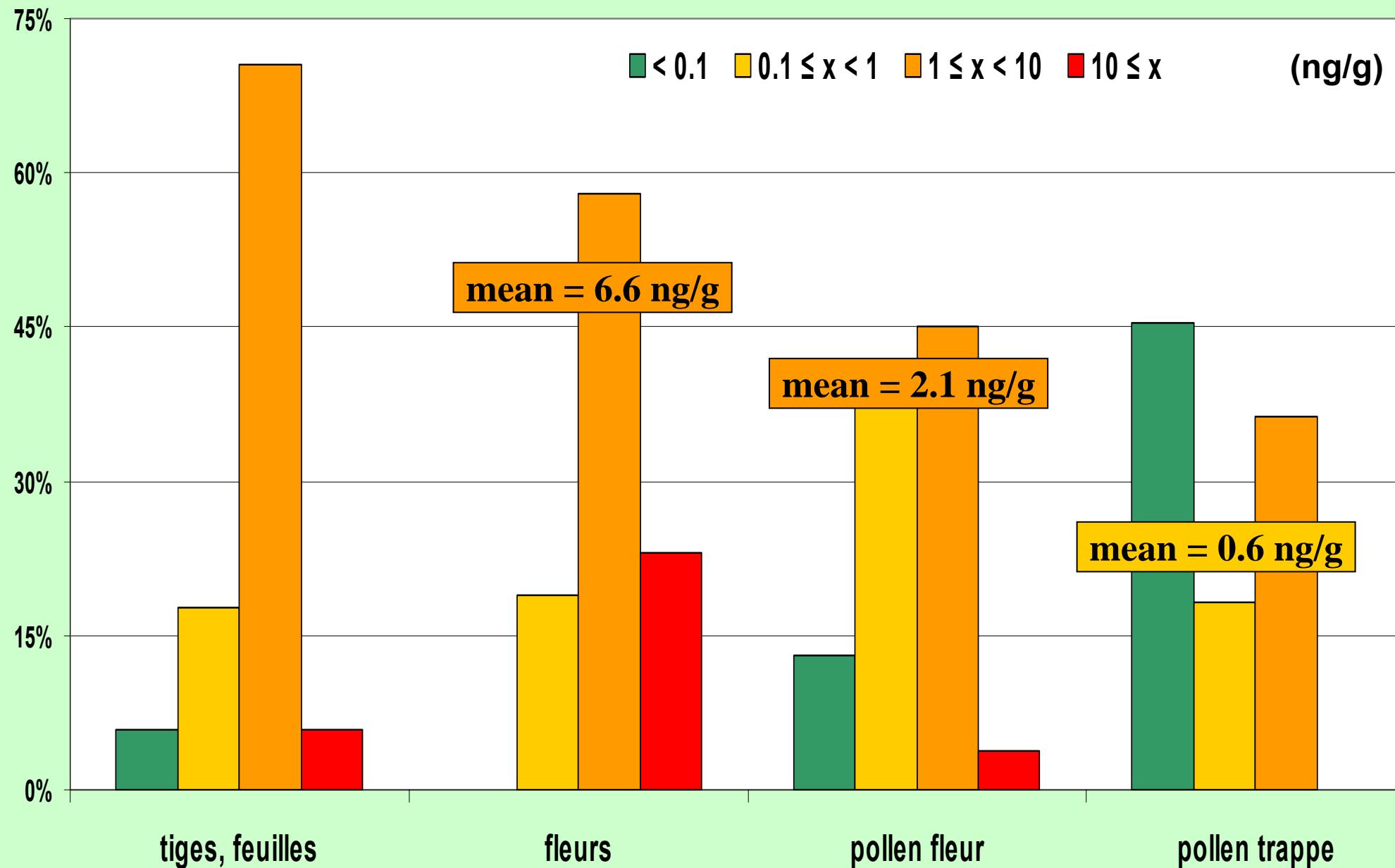


Distribution in sunflower (flowering)



- Units in nanogram/gram = 1 ng/g = 1 ppb = 1 μ g/kg = 0.000000001 g/g
- Bonmatin et al., Analytical Chemistry, 2003.

Distribution in maize (flowering)



Canola (USA)



Trapped pollen :

$3.1 < \text{mean} < 3.5 \text{ ppb}$

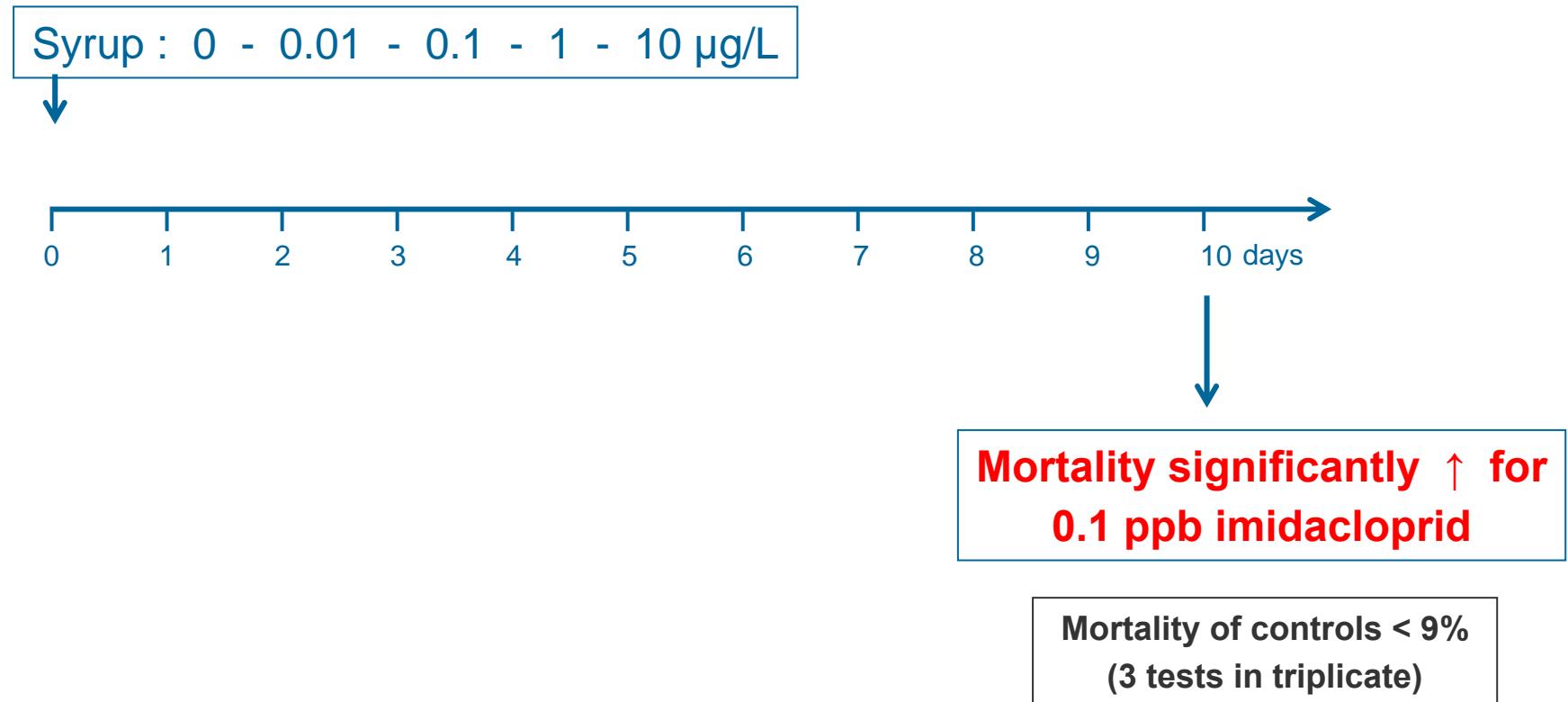
Nectar :

$0.5 < \text{mean} < 0.8 \text{ ppb}$

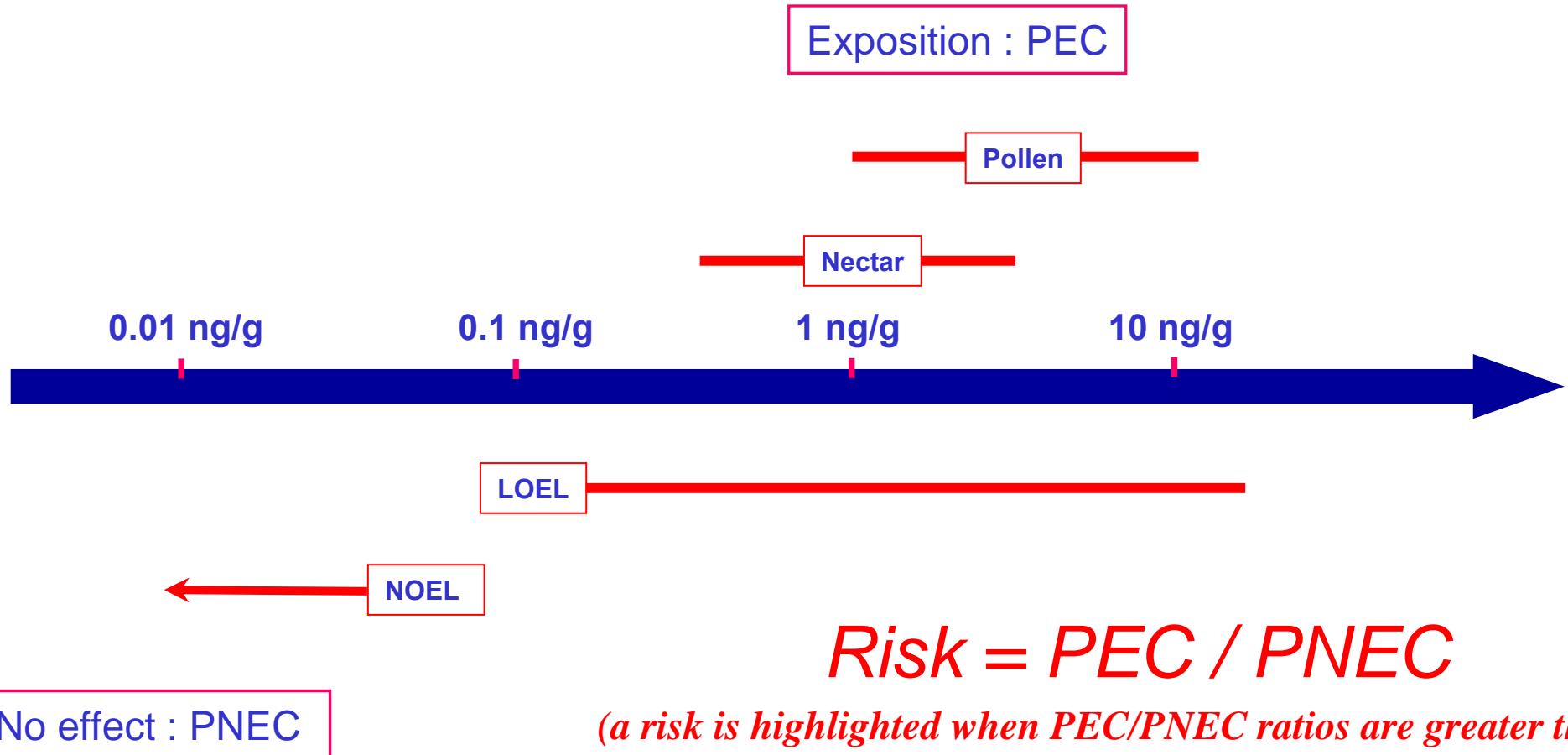
(Scott-Dupree & Spivak, 2000)

Subchronic Toxicity

Exposition of bees to imidacloprid far under the LD50 (4 ng/bee):



Effects of imidacloprid on bees : Risk assessment



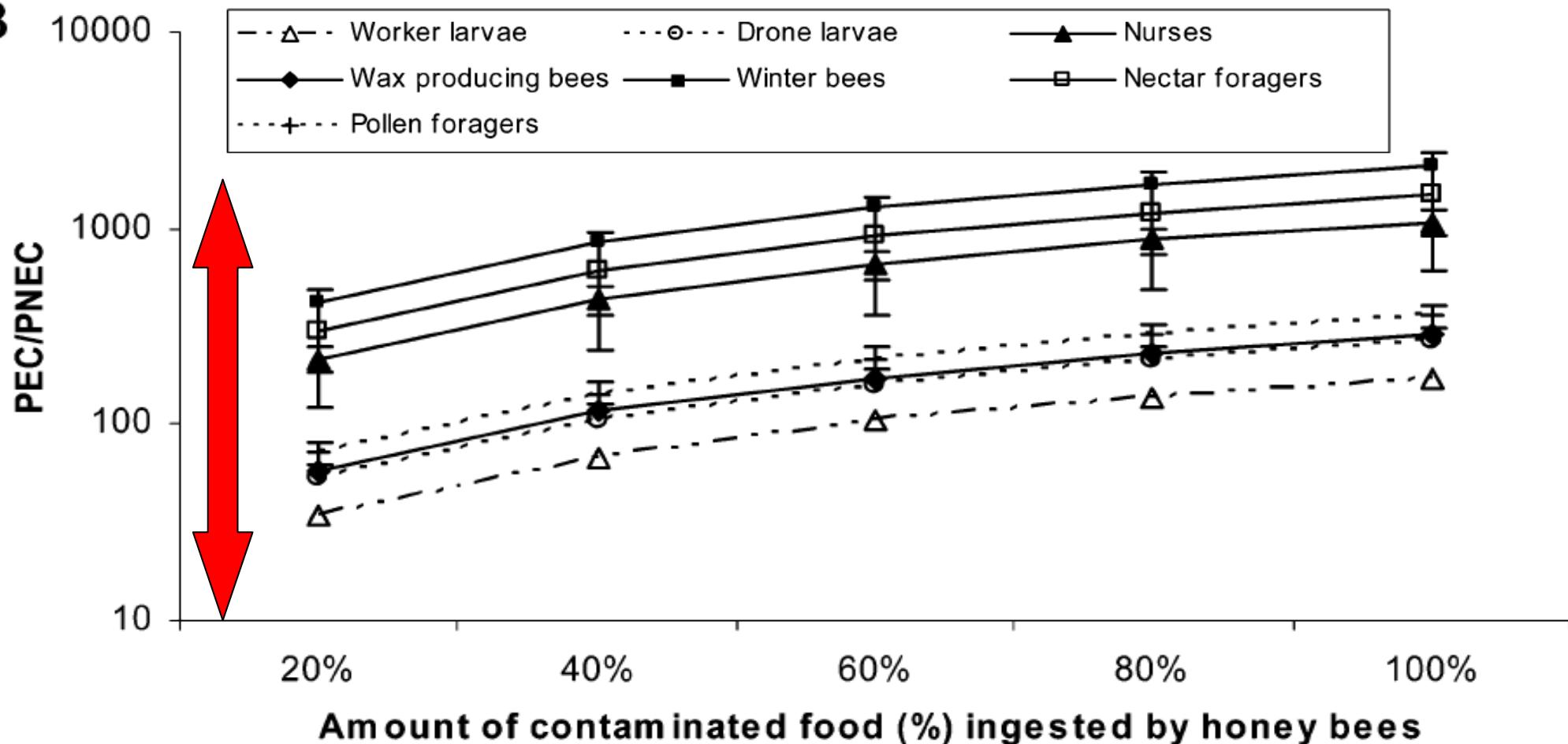
B

FIGURE 1. Hazard posed by **imidacloprid** to different categories of honey bees feeding on various proportions of contaminated food: estimated PEC/PNEC ratios derived from (B) **chronic toxicity** data, obtained in **field conditions for foragers** and in laboratory conditions for all the other categories of honey bees (a risk is highlighted when PEC/PNEC ratios are greater than 1).

- Comité Scientifique et Technique (CST) du trouble des abeilles, 2003 (on line)
- Halm et al., Environ. Sci. Technol. 2006, 40, 2448-2454.

Conclusion

Imidacloprid (Gaucho) :

- *A long persistence / soils ($t_{1/2} = 9$ months)*
- *An uptake in flowers (mean level at 7 ng/g)*
- *Mean level at 2-3 ng/g in pollen*
- *Sublethal effects at 2-4 ng/g (4 days)*
- *Chronic mortality from 0.1 ng/g (10 days)*
- *Main metabolites as much toxic as imidacloprid for bees*
- *High risk for the beehives (PEC/PNEC >> 1)*
- *Synergies with other pesticides, pathogens and parasites*
- *Generalization of these results to nicotinoids and pyrazoles
(clothianidin, thiamethoxam, fipronil...)*

Our références:

- Bonmatin, J.M., Marchand, P.A., Charvet, R., Moineau, I., Bengsch, E.R. & Colin, M.E. (2005) *J. Agric. Food Chem.* **53**, 5336-5341.
- Charvet, R., Katouzian-Safadi, M., Colin, M.E., Marchand, P.A., Bonmatin, J.M. (2004) *Annal. Pharm. Fr.* **62**, 29-35.
- Colin, M.E., Bonmatin, J.M., Moineau, I., Gaimon, C., Brun, S. & Vermandère, J.P. (2004) *Arch. Environ. Cont. Toxicol.* **47**, 387-395.
- Bonmatin, J.M., Marchand, P.A., Charvet, R. & Colin, M.E. (2004) Eurbee 1, (on line: <http://web.uniud.it/eurbee/>)
- Bonmatin, J.M., Moineau, I., Charvet, R., Fléché, C., Colin, M.E. & Bengsch, E.R. (2003) *Anal. Chem.* **75**, 2027-2033.
- Bonmatin, J.M. (2002) *Sciences* **2**, 42-46.

Collaborators

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- CNRS, Lab. Evolution, Génomes et Spéciation (Gif/Yvette), G. Arnold
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+ 50 %



Agriculture et alimentation