Assessing the precautionary principle: a challenge for modern agriculture?
ELO meeting Brussels, 24 April 2013

Late Lessons from Early Warnings: Seed-dressing systemic insecticides and honeybees

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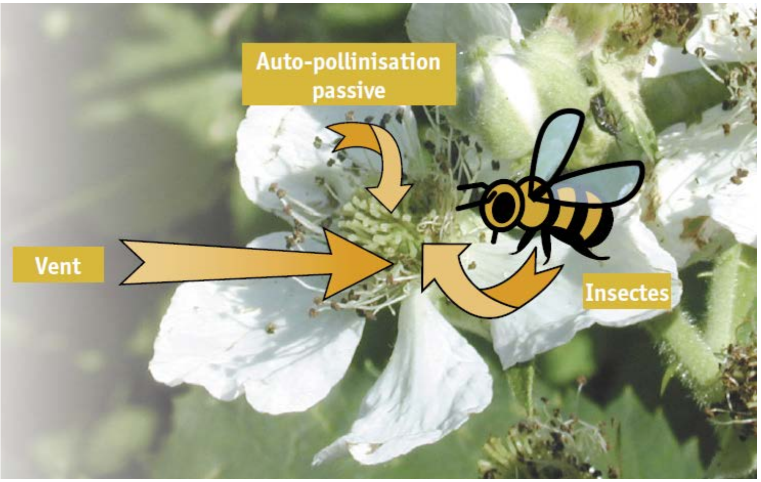
The importance of pollinators

- 90 major crops (35% world food production volume) depend on pollinators
- Key nutrients: 90-100% from pollinator mediated crops (vit C, antioxidants, lycopene, β-tocopherol, vit A and folic acid
- Value in Europe: 14.2 billion Euro / yr
- 87% of all flowering plants on earth depends on 25000 bee species for reproduction and evolution



Some crops pollinated by bees[3]

Alfalfa
Apple
Almond
Artichoke
Asparagus
Blackberry
Blueberry
Broccoli
Brussels sprouts
Cabbage
Cacao
Cantaloupe
Carrot
Cashew
Cauliflower
Celery
Cherry
Citrus
Dill
Eggplant/Aubergine
Fennel
Garlic
Kale
Kola nut
Leek
Lychee
Macadamia
Mango
Mustard
Nutmeg
Onion
Passion fruit
Peach
Pear
Plum
Pumpkin
Raspberry
Sapote
Squash
Sunflower
Tangerine
Tea
Watermelon

European Environment Agency Late Lessons II report 2013

- Assess the use of scientific evidence and the precautionary principle
- Wide range of case studies.
- Grouped in:
  - Health
  - Ecosystems
  - Emerging issues
- Chapter 16: **Seed-dressing systemic insecticides and honeybees**

http://www.bijensterfte.nl/sites/default/files/Chapter_16_Late_Lessons_II_Report_2013.pdf

Precautionary Principle (PP)

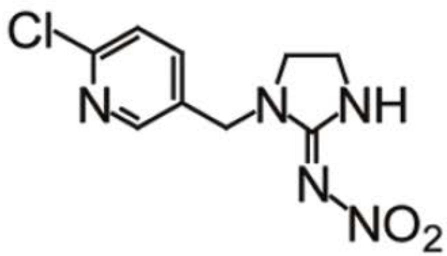
PP justifies policy interventions in cases where:

- scientific evidence of risk is insufficient, inconclusive or uncertain *and*
- there are indications through preliminary objective scientific evaluation that there are reasonable grounds for concern
- that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the chosen level of protection. (EU 2000)

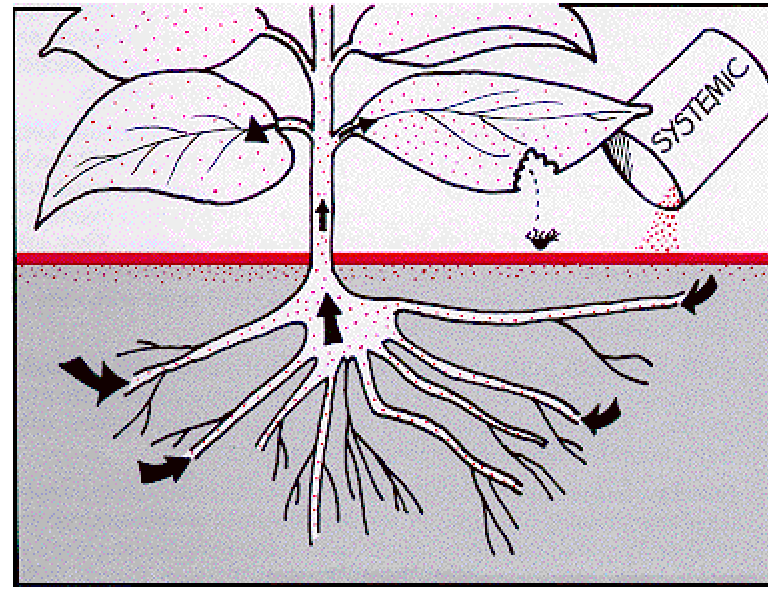
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2000:0001:FIN:EN:PDF

Systemic insecticides: revolution in plant protection

Shinzo Kagabu



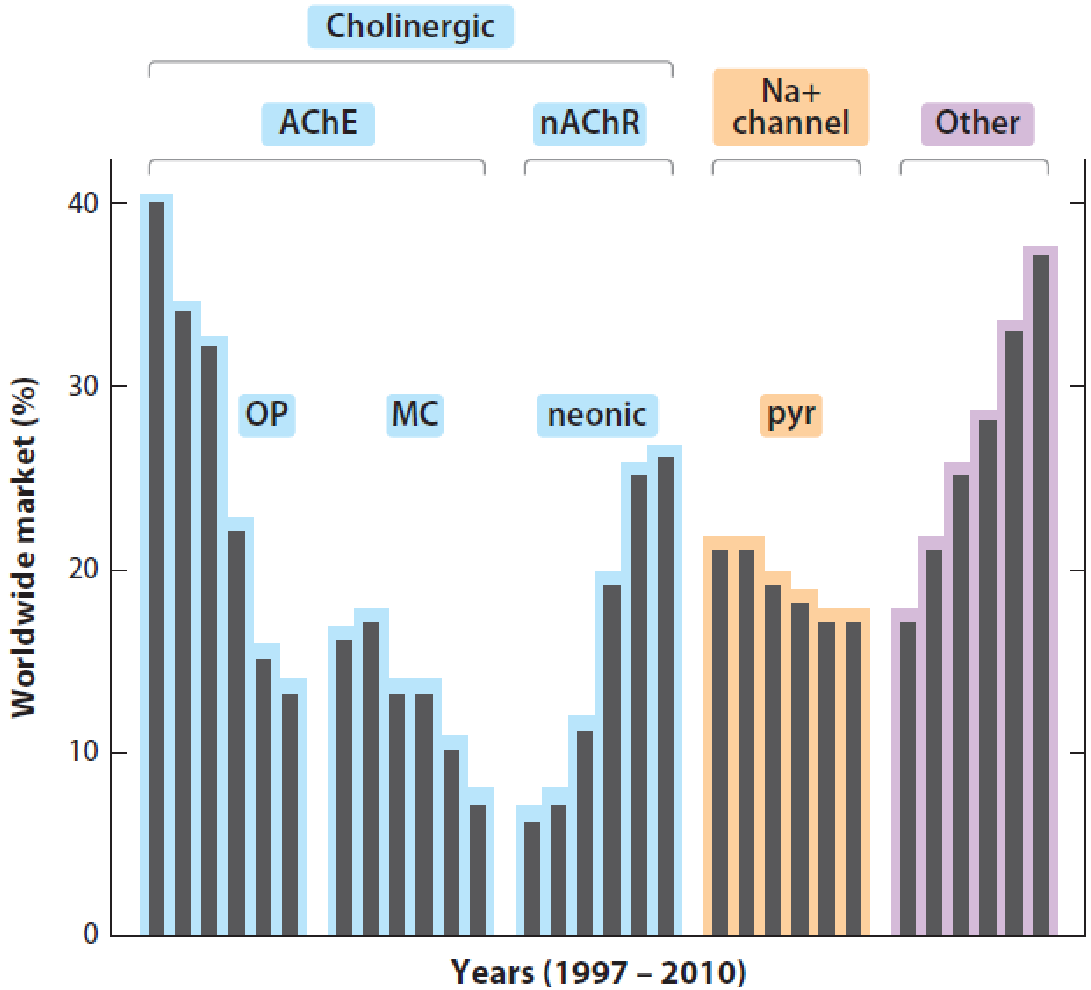
imidacloprid (1991)



Systemic = crop takes it up into its plantsap: chemical makes plant toxic from inside

Professor Shinzo Kagabu received the **2010 American Chemical Society International Award for Research in Agrochemicals** in recognition of his discovery of imidacloprid (IMI) and thiacloprid, which opened the **neonicotinoid era of *systemic* pest management**.

(Tomizawa & Casida, 2010, DOI:10.1021/jf103856c)



Imidacloprid 2010 World production: 20,000 tonnes

(DDT peak-use 80,000 tonnes in 1959)

Source: Casida and Durkin, 2013 doi: 10.1146/annurev-ento-120811-153645

Figure 4

Changes in use of insecticide classes between 1997 and 2010 showing decreases for organophosphates (OPs), methylcarbamates (MCs), and pyrethroids (pyr) and increases for neonicotinoids (neonic) and other compounds. Abbreviations: AChE, acetylcholinesterase; nAChR, nicotinic acetylcholine receptor. Data shown for the years 1997, 2000, 2002, 2005, 2008, and 2010 from T.C. Sparks (personal communication) are similar to those from his coauthored paper (95).

Toxicity of neonicotinoids

Pesticide	®	Use	LD50 (ng/honeybee)	Toxicity index relative to DDT
DDT	Dinocide	insecticide	27000	1
Amitraz	Apivar	insecticide / acaricide	12000	2
Coumaphos	Perizin	insecticide / acaricide	3000	9
Tau-fluvalinate	Apistan	insecticide / acaricide	2000	13.5
Methiocarb	Mesurol	insecticide	230	117
Carbofuran	Curater	insecticide	160	169
λ-cyhalothrin	Karate	insecticide	38	711
Deltamethrine	Decis	insecticide	10	2700
Thiamethoxam	Cruise	insecticide	5	5400
Fipronil	Regent	Insecticide	4.2	6475
Clothianidine	Poncho	Insecticide	4.0	6750
Imidacloprid	Gaucho	Insecticide	3.7	7297

Toxicity of insecticides to honeybees compared to DDT. The final column expresses the toxicity relative to DDT. (Source: Bonmatin, 2009)

http://www.bijensterfte.nl/images/Bonmatin-conclusions-sentinelle-gb-2009.pdf

Neonicotinoids

- Unprecedented scale of use: >1000 crops >120 countries
- High leaching potential: contamination of surface water
- High persistence in water & soil: build up in environment
- Broad spectrum toxicity - kills large range of non-target invertebrates
- Neurotoxic - bind irreversibly in nervous system causing cumulative and often delayed damage to non-target invertebrates (and vertebrates?)
- Ecosystem services provided by pollinators, soil decomposers, etc. are at risk
- Food web impacts are probable – large scale loss of invertebrates will lead to declines in vertebrate consumers.
- Most neonicotinoid use is unnecessary to reduce economic crop damage . Where action is needed, other strategies can be equally effective.

Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production

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Growing evidence for declines in bee populations has caused great concern due to the valuable ecosystem services they provide. Neonicotinoid insecticides have been implicated in these declines as they occur at trace levels in the nectar and pollen of crop plants. We exposed colonies of the bumble bee *Bombus terrestris* in the lab to field-realistic levels of the neonicotinoid imidacloprid, then allowed them to develop naturally under field conditions. Treated colonies had a significantly reduced growth rate and suffered an 85% reduction in production of new queens compared to control colonies. Given the scale of use of neonicotinoids, we suggest that they may be having a considerable negative impact on wild bumble bee populations across the developed world.

***Science*, 29 Mar 2012** http://dx.doi.org/10.1126/science.1215025

The French risk assessment of Gaucho® (1)

1994 – 1997: beekeepers reported unusual bee losses

Precautionary principle (French Minister of Agriculture)

⇒ ban of Gaucho® in sunflower seed-dressing in 1999

⇒ maize seed-dressing in 2004

The French risk assessment of Gaucho® (2)

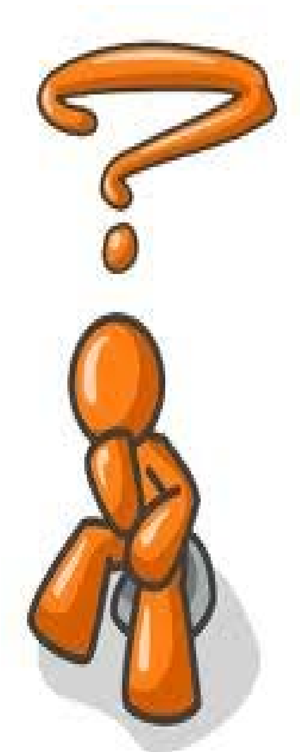
Companies produce the risk assessment for marketing pesticides => agencies

During authorization of Gaucho® for sunflower seed-dressing (**1993**):

- Wrong estimate of exposure
- Wrong estimate of effect (acute toxicity only, instead of chronic and sublethal)
- Wrong risk assessment method (based on the Hazard Quotient = the field application rate / oral or contact LD50)

The pesticide risk regulation was respected…

Risk assessment of neonicotinoids 14 years after PP



- The controversy revealed major failures in risk assessment procedures that still are used!
- At EU level, slow but ongoing work for adapting RA to fit systemic neurotoxins
- Risk assessment : normative and substantive nature

Regulatory myths about pesticide risk assessment: NORMATIVE dimension

Myth: “Representation of all the stakeholders concerned is not important for drafting standardized tests and guidelines – leave it to scientists”

Example: ICPBR Bee Brood WG (2008)

- Composition: 2 representatives of the industry, 3 of governmental agencies and 1 of a consulting company working for industry; academic scientists and beekeepers absent
- Proposed thresholds for considering a pesticide as being of low risk for the bee brood:
  - 30% loss of bee brood
  - 50% of eggs or other larval stages
- For beekeepers: unacceptable (these values = hives weakened on the long term)

Regulatory myths about pesticide risk assessment: SUBSTANTIVE (1)

Myth: “GLP warrant study quality”

- But GLP guarantees traceability of lab procedures, not the scientific quality
  - further scientific criteria required for judging validity of studies

Myth: “Standardized tests guarantee reproducibility and representativeness of the results + a high quality design”

- But field test guidelines were found to be inappropriate
  - problems with statistical power, reproducibility, representativeness, interpretation
  - Still, in present authorization procedures, field tests are considered more important than laboratory!

Regulatory myths about pesticide risk assessment: PROCEDURAL

Myth "Strict criteria for competence do not need to be specified when choosing the experts to include in a group"

- highly competent, specialised researchers not enough involved (many reasons: time, awareness)

Myth: "Expert judgment is a relevant way of access to the best scientific knowledge"

- Analysis of "expert judgements" on causal mechanisms has shown discrepancy, for some, with existing scientific literature & well established knowledge
  - Unwelcome knowledge ignored

Detailed quality analysis of risk assessments is needed at least for the most toxic pesicides

Late Lessons II report 2013

- Key decisions on innovation pathways made by few on behalf of many
- Lack of (institutional) mechanisms to respond to early warning signals
- Misleading market prices fail to reflect all costs and risks to society and nature

✓ Broaden application of the principles of precaution, prevention and polluter-pays

✓ Make government and business accountable

✓ Broaden evidence considered (lay/local knowledge) and public engagement

✓ Build resilience in governance systems and institutions

Plurality and uncertainty in risk assessment: lessons learned

- **Diversity of the knowledge base**:
  - It must be based on the full spectrum of available scientific knowledge;
- **Robustness of the knowledge claims**
  - Include uncertainty, dissent and criticism in the analysis, synthesis and assessments;
- Make thorough **Knowledge Quality Assessment the key task in the science policy interface** and develop a joint language to communicate limitations to our knowledge and understanding clearly and transparently
- Make use of **information of non-scientific sources** (local knowledge)
  - But scrutinize this information and be clear on its status;
- **Clarify values, stakes and vested interests** that play a role in research and in the political and socioeconomic context within which the research is embedded.

(Maxim and van der Sluijs, 2007, 2012)

Looking to the future

- Upstream precaution:
  - **Precaution should guide innovation in stead of being emergency break**
  - Current *lock-in* on persistent broad-acting neurotoxic systemic insecticides is not sustainable: **collateral damage guaranteed**
  - Green Chemistry challenge: design pest-insect specific non-persistent insecticides
  - **Integrated Pest Management!**