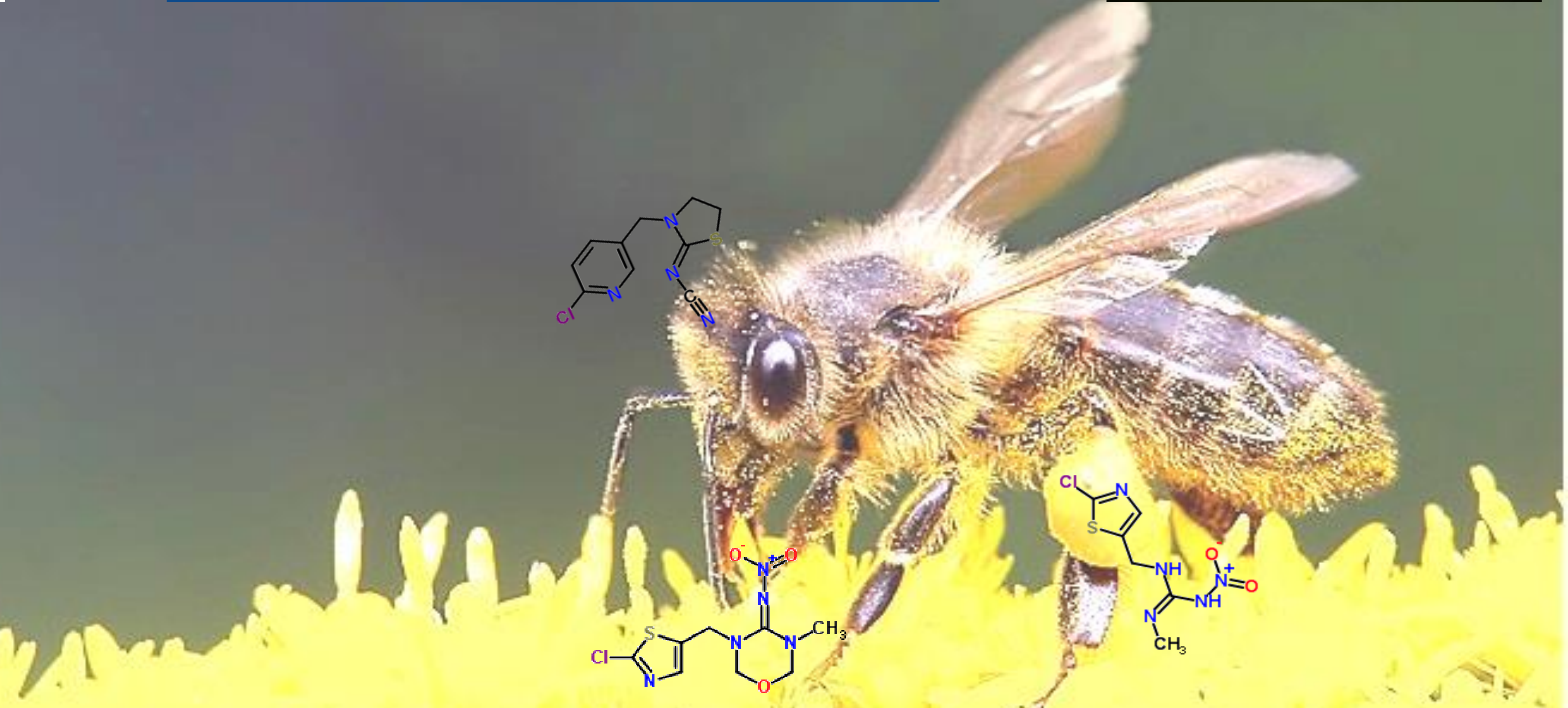
Post-Neonikotinoid-Symposium

01. Dezember 2015

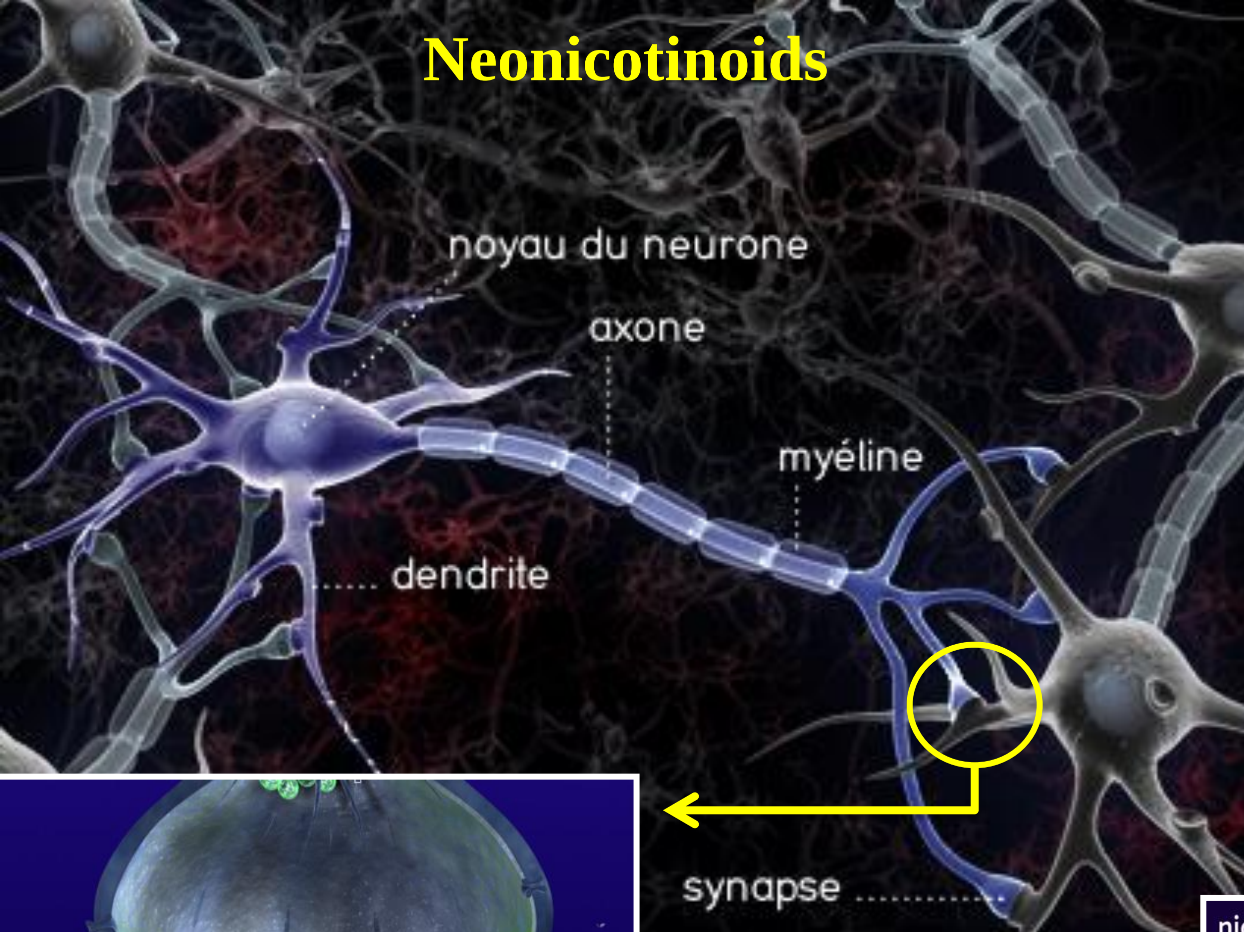
Festsaal der Humboldt-Universität zu Berlin

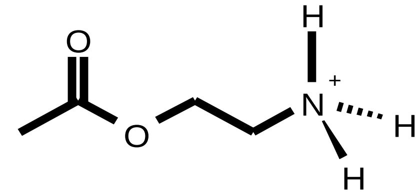


Unsustainable agriculture with neonicotinoid insecticides: Large scale impacts on biodiversity

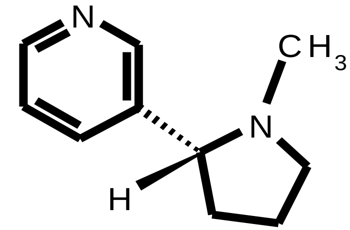
Dr JM Bonmatin, CNRS France & Vice-chair TFSP

Neonicotinoids

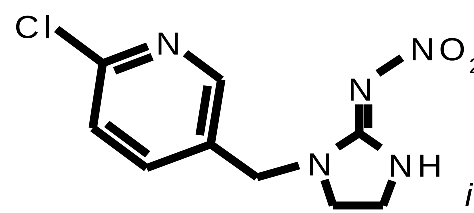




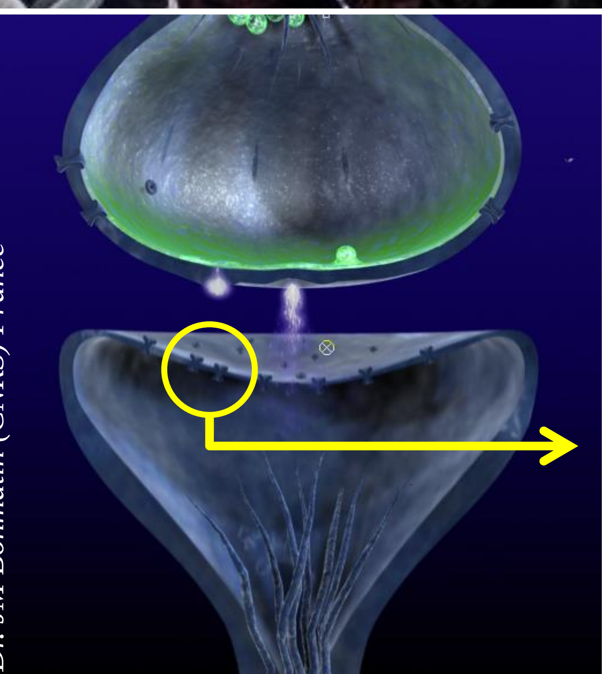
ACh

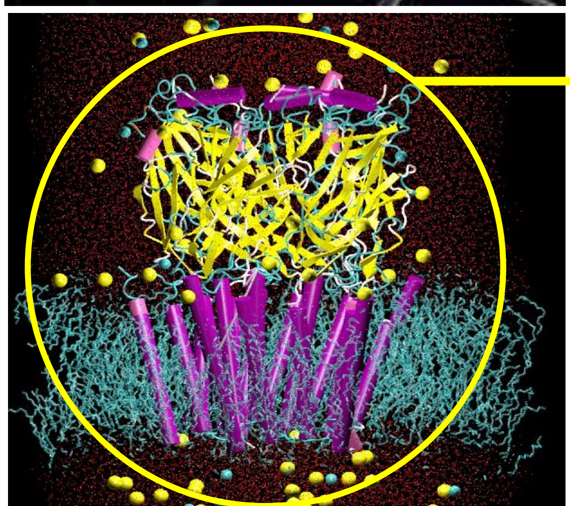


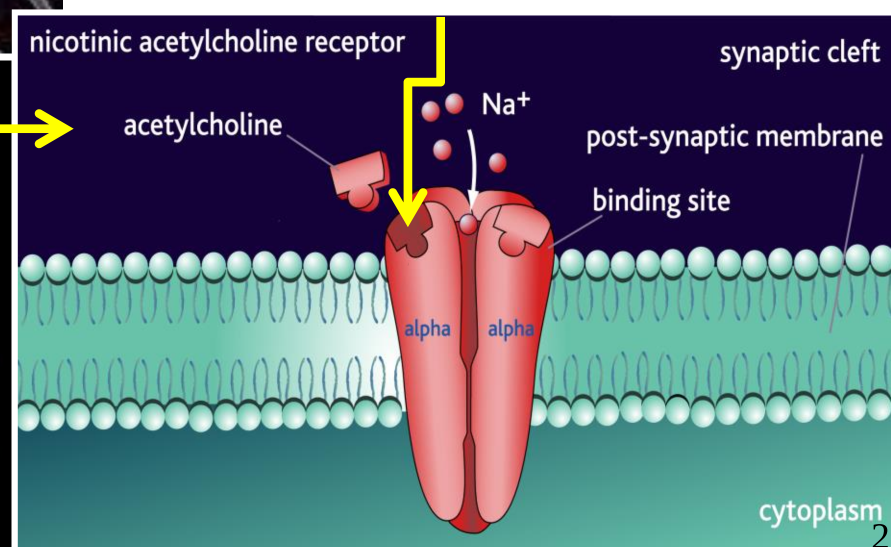
nicotine



imidaclopride



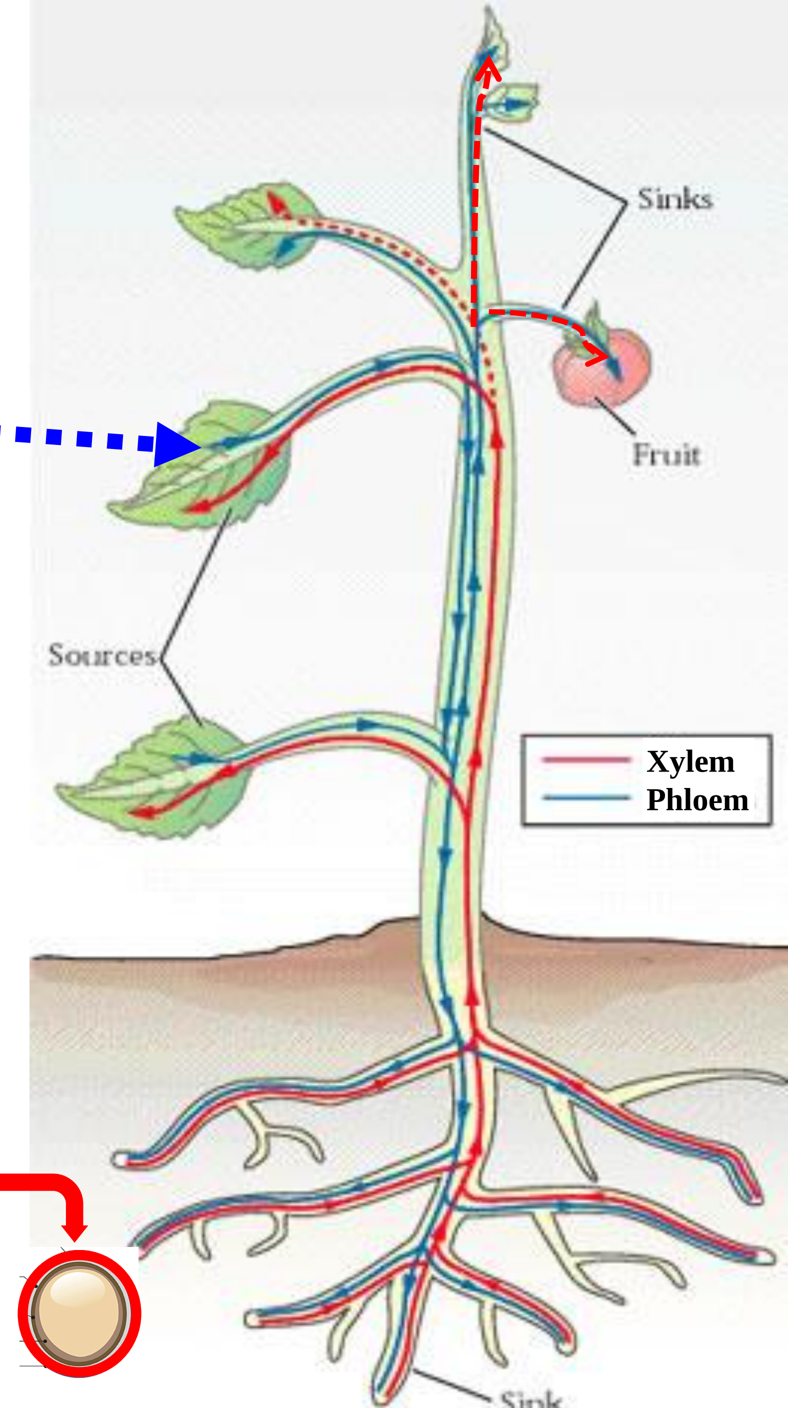




Dr. JM Bonmatin (CNRS) France

Translaminar insecticides (~1 kg/ha)

Systemic insecticides (~100 g/ha)



Acute toxicity to honeybees

pesticide	®	Use	Dose g/ha	LD50 ng/ab	Tox/DDT
DDT	Dinocide	insecticide	200-600	27 000.0	1
thiaclopride	Proteus	insecticide	62,5	12 600.0	2.1
amitraze	Apivar	acaricide	-	12 000.0	2.3
acetamiprid	Supreme	insecticide	30-150	7 100.0	3.8
coumaphos	Perizin	acaricide	-	3 000.0	9
methiocarb	Mesurol	insecticide	150-2200	230.0	117
tau-fluvalinate	Apistan	acaricide	-	200.0	135
carbofuran	Curater	insecticide	600	160.0	169
λ-cyhalothrine	Karate	insecticide	150	38.0	711
thiaméthoxam	Cruiser	insecticide	69	5.0	5 400
fipronil	Regent	insecticide	50	4.2	6 475
imidaclopride	Gaucho	insecticide	75	3.7	7 297
clothianidine	Poncho	insecticide	50	2.5	10 800
deltamethrine	Décis	insecticide	7,5	2.5	10 800

Environ Sci Pollut Res
DOI 10.1007/s11356-014-3471-x

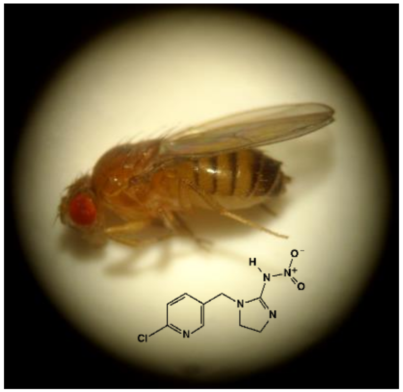
WORLDWIDE INTEGRATED ASSESSMENT OF THE IMPACT OF SYSTEMIC PESTICIDES ON BIODIVERSITY AND ECOSYSTEMS

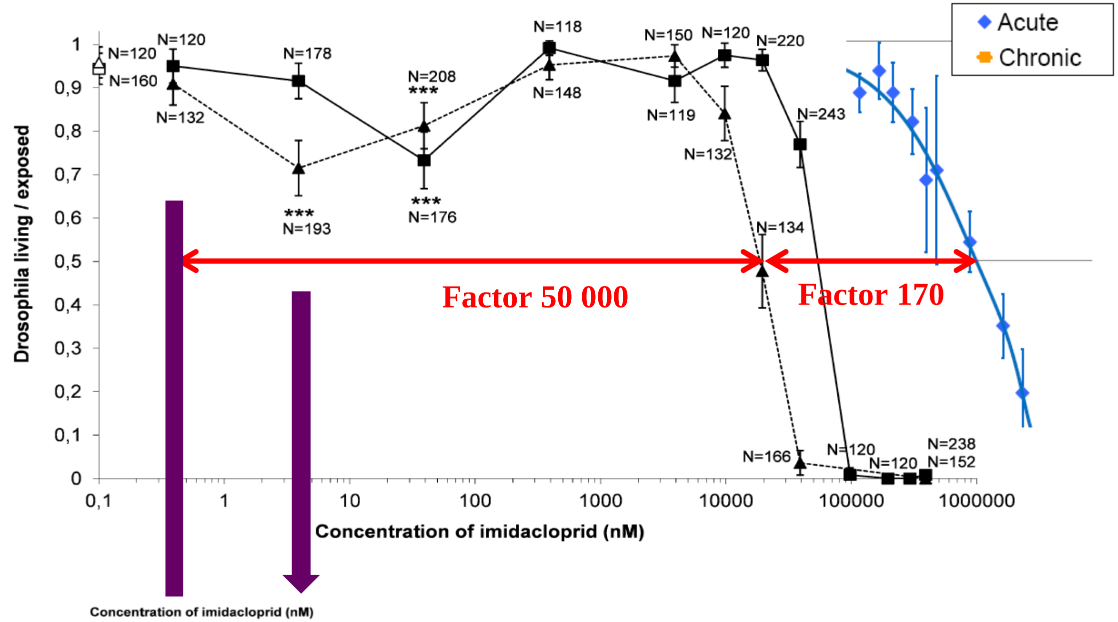
Effects of neonicotinoids and fipronil on non-target invertebrates

Environmental Science & Technology
Article
pubs.acs.org/est

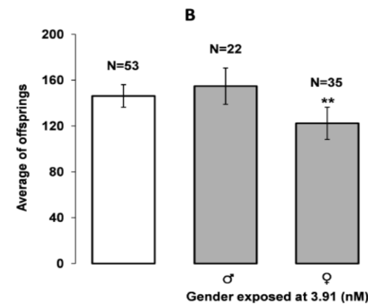
Lethal and Sublethal Effects of Imidacloprid, After Chronic Exposure, On the Insect Model *Drosophila melanogaster*

Gaël Charpentier,[†] Fanny Louat,[†] Jean-Marc Bonmatin,[*,†] Patrice A. Marchand,[†] Fanny Vanier,[†] Daniel Locker,[†,‡] and Martine Decoville[†,‡]



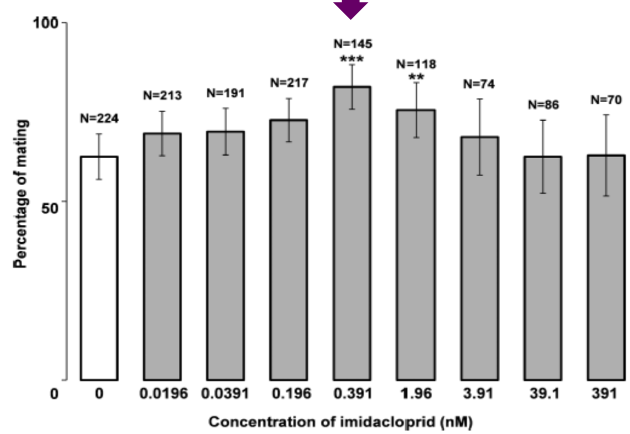


Fecondity –16%



Chronic LOEC (0,1 ng/g)

Mating +30 %



♂ acute LC50 / 3 300 000

♀ acute LC50 / 8 600 000

Sciencexpress

Report

EMBARGOED UNTIL 2:00 PM US ET THURSDAY, 29 MARCH 2012

A Common Pesticide Decreases Foraging Success and Survival in Honey Bees

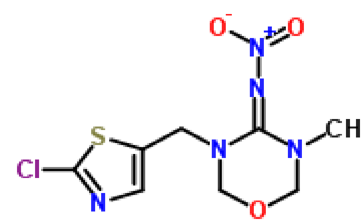
Mickaël Henry,[1]* Maxime Beguin,[2] Fabrice Requier,[3,4] Orianne Rollin,[1,5] Jean-François Odoux,[4] Pierrick Aupinel,[4] Jean Aptel,[1] Sylvie Tchamitchian,[1] Axel Decourtye[5]

[1]INRA, UR406 Abeilles et Environnement, F-84914 Avignon, France. [2]Association pour le développement de l'apiculture provençale (ADAPI), F-13626 Aix-en-Provence, France. [3]Centre d'Etudes Biologiques de Chizé, CNRS (USC-INRA 1339), UPR1934, F-79360 Beauvoir-sur-Niort, France. [4]INRA, UE1255, UE Entomologie, F-17700 Surgères, France. [5]ACTA, UMT PrADE, UR 406 Abeilles et Environnement, F-84914 Avignon, France.

*To whom correspondance should be addressed. E-mail: mickael.henry@avignon.inra.fr

Non-lethal exposure of honey bees to thiamethoxam (neonicotinoid systemic pesticide) causes high mortality due to homing failure at levels that could put a colony at risk of collapse. Simulated exposure events on free-ranging foragers labeled with an RFID tag suggest that homing is impaired by thiamethoxam intoxication. These experiments offer new insights into the consequences of common neonicotinoid pesticides used worldwide.

Thiamethoxam



authorization procedures now require running mortality surveys to ensure doses encountered in the field remain below lethal levels for honey bees.

However, a growing body of evidence shows that sublethal doses, i.e., doses that do not entail direct mortality, still have the potential to induce a variety of behavioral difficulties in foraging honey bees, such as memory and learning dysfunctions and alteration of navigational skills (*9*). Neonicotinoid pesticides used to protect crops against aphids and other sap-sucking insects are especially liable to provoke such behavioral troubles. They are highly potent and selective agonists of nicotinic acetylcholine receptors, which are important excitatory neurotransmitter receptors in insects (*10*, *11*). Effects of sublethal neonicotinoid exposures in honey bees may include abnormal foraging activity (*12–14*), reduced olfactory memory and learning performance (*15–17*) and possibly impaired orienta-

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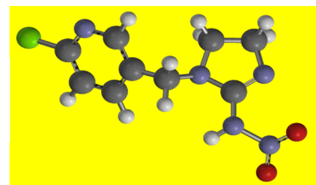
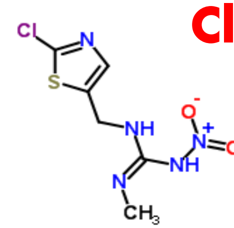
ISSN 1721-8861

Sub-lethal exposure to neonicotinoids impaired honey bees winterization before proceeding to colony collapse disorder

Chensheng Lu[1], Kenneth M. Warchol[2], Richard A. Callahan[3]
[1] *Department of Environmental Health, Harvard School of Public Health, Landmark Center West, Boston, MA, USA*
[2] *Worcester County Beekeepers Association, Northbridge, MA, USA*
[3] *Worcester County Beekeepers Association, Holden, MA, USA*

Imidacloprid





Clothianidin

Abstract

Honey bee (*Apis mellifera* L.) colony collapse disorder (CCD) that appeared in 2005/2006 still lingers in many parts of the world. Here we show that sub-lethal exposure of neonicotinoids, imidacloprid or clothianidin, affected the winterization of healthy colonies that subsequently leads to CCD. We found honey bees in both control and neonicotinoid-treated groups progressed almost identically through the summer and fall seasons and observed no acute morbidity or mortality in either group until the end of winter. Bees from six of the twelve neonicotinoid-treated colonies had abandoned their hives, and were eventually dead with symptoms resembling CCD. However, we observed a complete opposite phenomenon in the control colonies in which instead of abandonment, they were re-populated quickly with new emerging bees. Only one of the six control colonies was lost due to *Nosema*-like infection. The observations from this study may help to elucidate the mechanisms by which sub-lethal neonicotinoids exposure caused honey bees to vanish from their hives.

Key words: colony collapse disorder, CCD, honey bee, neonicotinoids, imidacloprid, clothianidin.

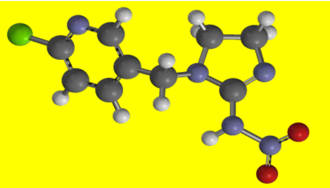
Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production

Penelope R. Whitehorn,[1] Stephanie O'Connor,[1] Felix L. Wackers,[2] Dave Goulson[1*]

Growing evidence for declines in bee
valuable ecosystem services they pro
these declines because they occur at
We exposed colonies of the bumble
levels of the neonicotinoid imidaclop
field conditions. Treated colonies ha
85% reduction in production of new
of use of neonicotinoids, we suggest
wild bumble bee populations across

Bees in agroecosystems survive
ing on wildflowers growing
margins and patches of semina
itat, supplemented by the brief gluts
provided by mass flowering crops su
seed rape and sunflower (*1*, *2*). Many
now routinely treated with neonico

have shown some evidence that neonicotinoids reduced forager success under field conditions, no studies have examined their impacts on colonies foraging naturally in the field. Here, we present an experiment, using 75 *Bombus terrestris* colonies, designed to simulate the likely effect of exposure of a wild bumble bee colony to neonicotinoids present on the flowers of a nearby crop. The colonies were random-



Imidacloprid

www.nature.com/scientificreports

OPEN

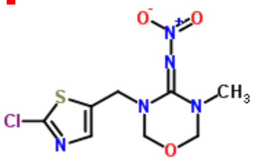
Neonicotinoid pesticides severely affect honey bee queens

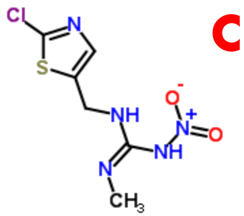
Geoffrey R. Williams[1,2], Aline Troxler[1,2], Gina Retschnig[1,2], Kaspar Roth[1,2], Orlando Yañez[1,2], Dave Shutler[3], Peter Neumann[1,2,4] & Laurent Gauthier[2]

Received: 18 May 2015
Accepted: 23 July 2015
Published: 13 October 2015

Queen health is crucial to colony survival of social bees. Recently, queen failure has been proposed to be a major driver of managed honey bee colony losses, yet few data exist concerning effects of environmental stressors on queens. Here we demonstrate for the first time that exposure to field-realistic concentrations of neonicotinoid pesticides during development can severely affect queens of western honey bees (*Apis mellifera*). In pesticide-exposed queens, reproductive anatomy (ovaries) and physiology (spermathecal-stored sperm quality and quantity), rather than flight behaviour, were compromised and likely corresponded to reduced queen success (alive and producing worker offspring). This study highlights the detriments of neonicotinoids to queens of environmentally and economically important social bees, and further strengthens the need for stringent risk assessments to safeguard biodiversity and ecosystem services that are vulnerable to these substances.

Thiamethoxam





Clothianidin

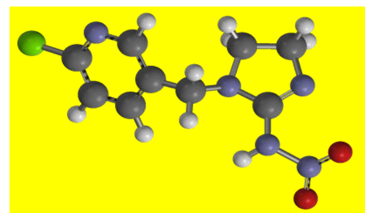
Neonicotinoid clothianidin adversely affects insect immunity and promotes replication of a viral pathogen in honey bees

Gennaro Di Prisco[a], Valeria Cavaliere[b], Desiderato Annoscia[c], Paola Varricchio[a], Emilio Caprio[a], Francesco Nazzi[c], Giuseppe Gargiulo[b], and Francesco Pennacchio[a,1]

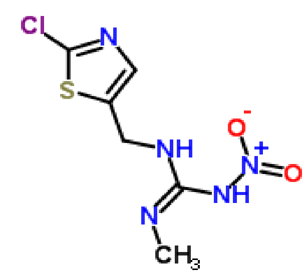
[a]Dipartimento di Agraria, Laboratorio di Entomologia E. Tremblay, Università degli Studi di Napoli Federico II, I-80055 Portici, Italy; [b]Dipartimento di Farmacia e Biotecnologie, Università di Bologna, I-40126 Bologna, Italy; and [c]Dipartimento di Scienze Agrarie e Ambientali, Università degli Studi di Udine, I-33100 Udine, Italy

Edited by Gene E. Robinson, University of Illinois at Urbana–Champaign, Urbana, IL, and approved October 1, 2013 (received for review August 8, 2013)

Large-scale losses of honey bee colonies represent a poorly understood problem of global importance. Both biotic and abiotic factors are involved in this phenomenon that is often associated with high loads of parasites and pathogens. A stronger impact of pathogens in honey bees exposed to neonicotinoid insecticides has been reported, but the causal link between insecticide exposure and the possible immune alteration of honey bees remains elusive. Here, we demonstrate that the neonicotinoid insecticide clothianidin negatively modulates NF-κB immune signaling in insects and adversely affects honey bee antiviral defenses controlled by this transcription factor. We have identified in insects a negative modulator of NF-κB activation, which is a leucine-rich repeat protein. Exposure to clothianidin, by enhancing the transcription of the gene encoding this inhibitor, reduces immune defenses and promotes the replication of the deformed wing virus in honey bees bearing covert infections. This honey bee immunosuppression is similarly induced by a different neonicotinoid, imidacloprid, but not by the organophosphate chlorpyriphos, which does not affect NF-κB signaling. The occurrence at sublethal doses of this insecticide-induced viral proliferation suggests that the



Imidacloprid



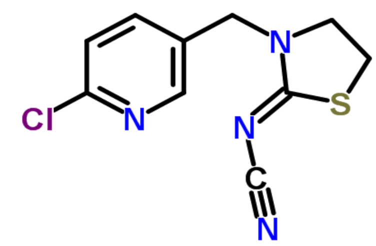
Clothianidin

OPEN ACCESS Freely available online
PLoS one

Exposure to Sublethal Doses of Fipronil and Thiacloprid Highly Increases Mortality of Honeybees Previously Infected by *Nosema ceranae*

Cyril Vidau[1,2], Marie Diogon[1,2], Julie Aufauvre[1,2], Régis Fontbonne[1,2], Bernard Viguès[1,2], Jean-Luc Brunet[3], Catherine Texier[2], David G. Biron[1,2], Nicolas Blot[1,2], Hicham El Alaoui[1,2], Luc P. Belzunces[3], Frédéric Delbac[1,2]*

1 Clermont Université, Université Blaise Pascal, Laboratoire Microorganismes: Génome et Environnement, BP 10448, Clermont-Ferrand, France, 2 CNRS, UMR 6023, LMGE, Aubière, France, 3 INRA, UMR 406 Abeilles & Environnement, Laboratoire de Toxicologie Environnementale, Site Agroparc, Avignon, France



Abstract

Background: The honeybee, *Apis mellifera*, is undergoing a worldwide decline whose origin is still in debate. Studies performed for twenty years suggest that this decline may involve both infectious diseases and exposure to pesticides. Joint action of pathogens and chemicals are known to threaten several organisms but the combined effects of these stressors were poorl
honeybee s

Methodolo
controls, (ii)
infected wi
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Conclusion
ceranae-infe
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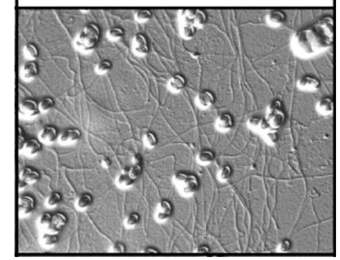
hypothesis
contribute

Nosema ceranae



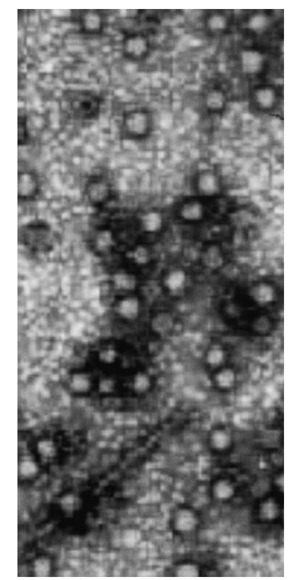
Citation: Vidau
Honeybees Previ
Editor: Elizabeth
Received March

environmental microbiology
society for applied microbiology sfam
Environmental Microbiology (2014) doi:10.1111/1462-2920.12426

Bees under stress: sublethal doses of a neonicotinoid pesticide and pathogens interact to elevate honey bee mortality across the life cycle

Vincent Doublet,[1*†] Maureen Labarussias,[1] Joachim R. de Miranda,[2] Robin F. A. Moritz[1,3] and Robert J. Paxton[1,3,4]

Thiacloprid + *nosema*
Thiacloprid + BQCV



Neonicotinoid-Coated *Zea mays* Seeds Indirectly Affect Honeybee Performance and Pathogen Susceptibility in Field Trials

Mohamed Alburaki[1,3¤]*, Sébastien Boutin[1], Pierre-Luc Mercier[1,3], Yves Loublier[5], Madeleine Chagnon[4], Nicolas Derome[1,2]

PLOS ONE | DOI:10.1371/journal.pone.0125790 May 18, 2015

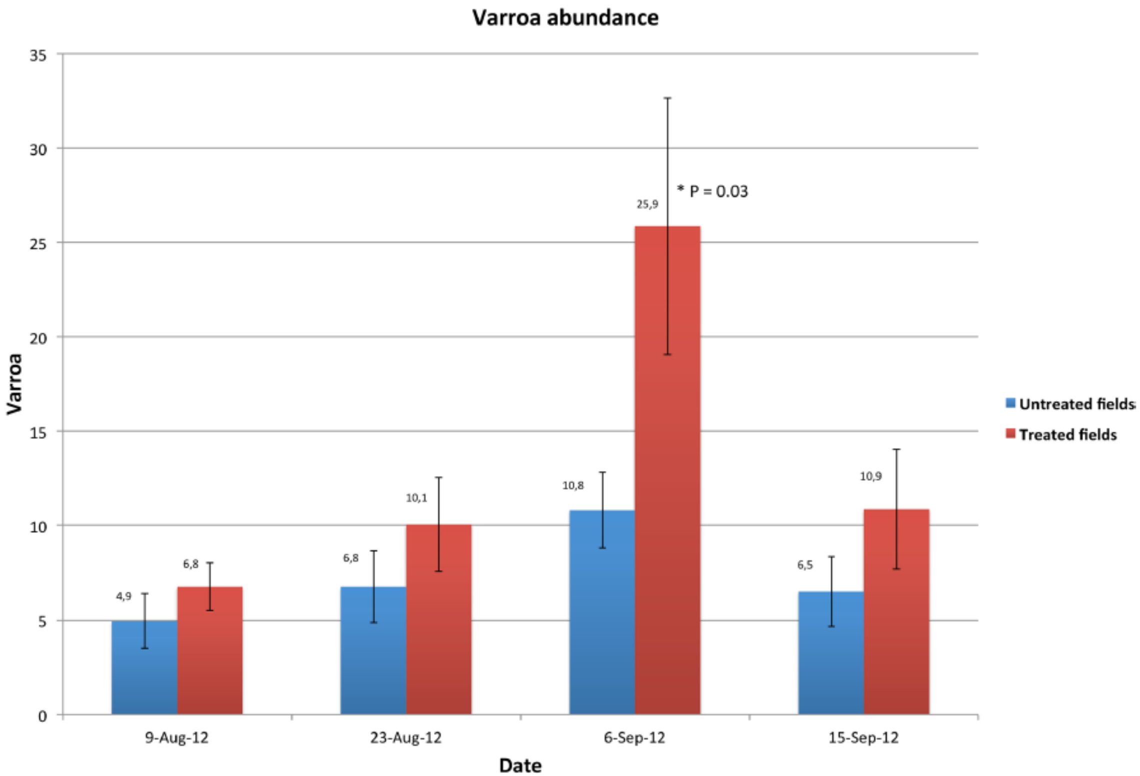
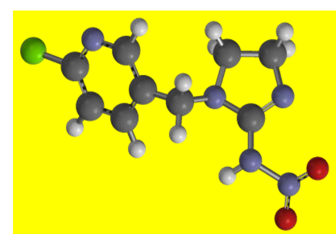


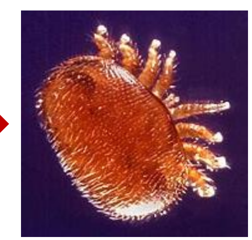
Fig 4. Mean values of varroa mite abundance in the 32 studied colonies, 16 colonies in each treated and untreated cornfields on four different dates. Error bars are the Standard Errors (SE) of each studied group. P values is * P < 0.05.

Abstract

Thirty-two honeybee (*Apis mellifera*) colonies were studied in order to detect and measure potential *in vivo* effects of neonicotinoid pesticides used in cornfields (*Zea mays* spp) on honeybee health. Honeybee colonies were randomly split on four different agricultural cornfield areas located near Quebec City, Canada. Two locations contained cornfields treated with a seed-coated systemic neonicotinoid insecticide while the two others were organic cornfields used as control treatments. Hives were extensively monitored for their performance and health traits over a period of two years. Honeybee viruses (brood queen cell virus BQCV, deformed wing virus DWV, and Israeli acute paralysis virus IAPV) and the brain specific expression of a biomarker of host physiological stress, the Acetylcholinesterase gene AChE, were investigated using RT-qPCR. Liquid chromatography-mass spectrometry (LC-MS) was performed to detect pesticide residues in adult bees, honey, pollen, and corn flowers collected from the studied hives in each location. In addition, general hive conditions were assessed by monitoring colony weight and brood development. Neonicotinoids were only identified in corn flowers at low concentrations. However, honeybee colonies located in neonicotinoid treated cornfields expressed significantly higher pathogen infection than those located in untreated cornfields. AChE levels showed elevated levels among honeybees that collected corn pollen from treated fields. Positive correlations were recorded between pathogens and the treated locations. Our data suggests that neonicotinoids indirectly weaken honeybee health by inducing physiological stress and increasing pathogen loads.



Imidacloprid



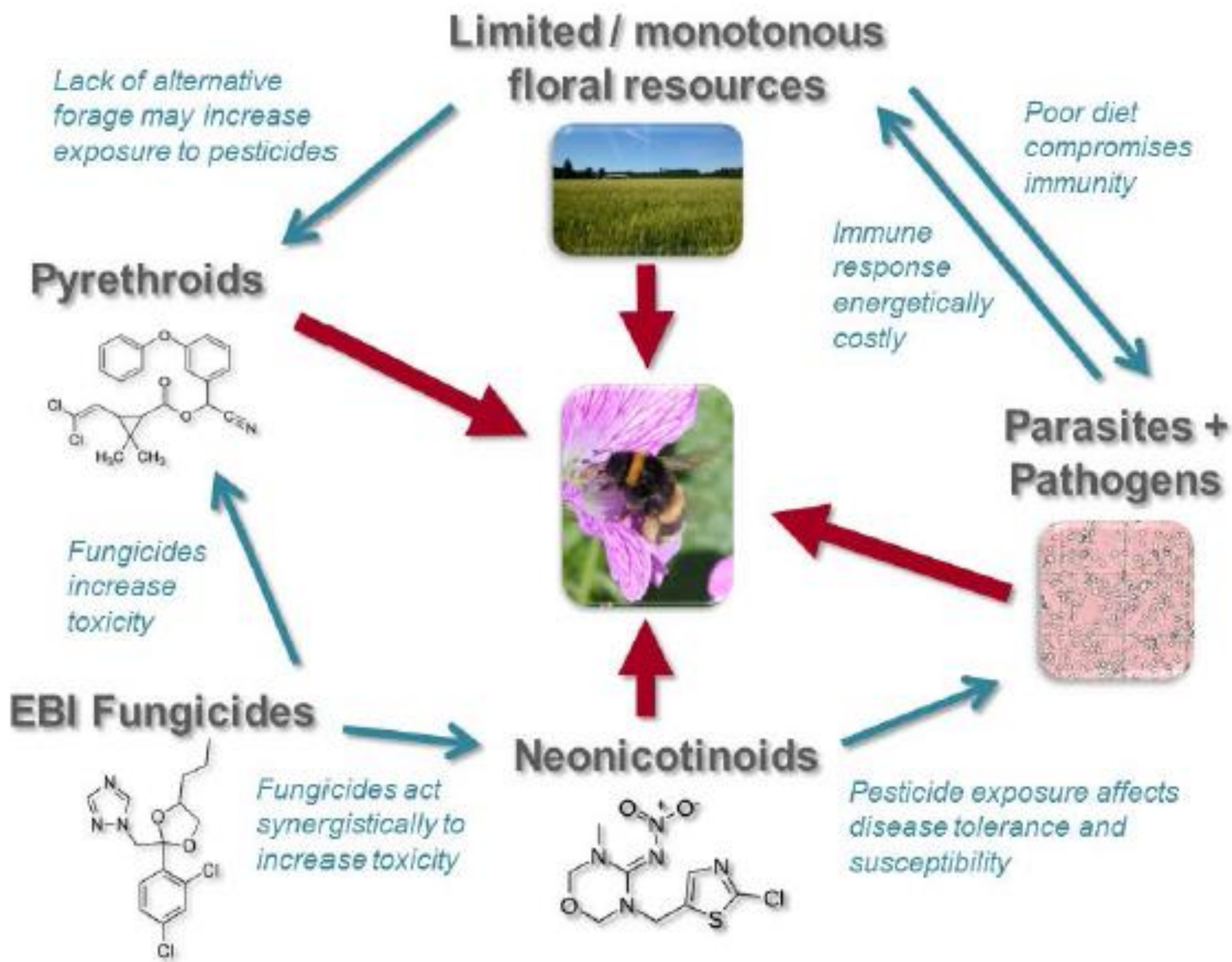
Bee declines driven by combined stress from parasites, pesticides, and lack of flowers

Dave Goulson,* Elizabeth Nicholls, Cristina Botías, Ellen L. Rotheray

School of Life Sciences, University of Sussex, Falmer, Brighton BN1 9QG, UK.

*Corresponding author. E-mail: d.goulson@sussex.ac.uk

www.sciencemag.org on February 26, 2015




anses
agence nationale de sécurité sanitaire
alimentation, environnement, travail
Connaître, évaluer, protéger

Co-exposition
des abeilles
aux facteurs de stress

Avis de l'Anses
Rapport d'expertise collective

Juillet 2015 Édition scientifique

Proposals for pesticide registration:
==> mandatory tests of co-exposure

- *e.g.* insecticide + anti *varroa* products
- *e.g.* insecticide + fungicide
- *e.g.* insecticide + insecticide

and lab test & epidemiologic surveys

- *e.g.* insecticide + viruses
- *e.g.* insecticide + *nosema spp*
- *e.g.* insecticide + *varroa spp*

Conclusions (extract)

Devant le constat de la multiplicité et de l'ampleur de l'exposition aux substances chimiques utilisées en santé des plantes et des animaux d'élevage, il est impératif d'œuvrer de toutes les manières possibles pour une diminution globale des intrants.

Facing the multiplicity and the magnitude of chemical substances used for crop protection and for animal breeding, it is imperative to act with all possible means for globally reducing chemical inputs.

European Red List of Bees

Ana Nieto, Stuart P.M. Roberts, James Kemp, Pierre Rasmont, Michael Kuhlmann, Mariana García Criado, Jacobus C. Biesmeijer, Petr Bogusch, Holger H. Dathe, Pilar De la Rúa, Thibaut De Meulemeester, Manuel Dehon, Alexandre Dewulf, Francisco Javier Ortiz-Sánchez, Patrick Lhomme, Alain Pauly, Simon G. Potts, Christophe Praz, Marino Quaranta, Vladimir G. Radchenko, Erwin Scheuchl, Jan Smit, Jakub Straka, Michael Terzo, Bogdan Tomozii, Jemma Window and Denis Michez

The European Red List of Bees provides, for the first time, factual information on the status of all bees in Europe, nearly 2,000 species. This new assessment shows us that 9% of bees are threatened with extinction in Europe mainly due to habitat loss as a result of agriculture intensification (e.g., changes in agricultural practices including the use of pesticides and fertilisers), urban development, increased frequency of fires and climate change.

Pia Bucella
Director
Directorate B: Natural Capital
European Commission

Recommendations

- Improve the advice to farmers, landowners, managers of public and amenity spaces and gardeners on best practices for using insecticides. This should draw upon research evidence to provide guidance which takes into account the diverse life histories of European bees and other pollinators.
- Commit to a sustainable long-term reduction in the use of pesticides, with quantitative targets for the reductions in the total application of all pesticide active ingredients, and encourage the uptake of alternative pest management methods including the use of natural enemies and Integrated Pest Management (IPM).

Environ Sci Pollut Res
DOI 10.1007/s11356-014-3220-1

EDITORIAL

The Task Force on Systemic Pesticides
WWW.TFSP.INFO

Worldwide integrated assessment on systemic pesticides

Global collapse of the entomofauna: exploring the role of systemic insecticides

Maarten Bijleveld van Lexmond • Jean-Marc Bonmatin •
Dave Goulson • Dominique A. Noome

8 scientific articles

- **First meta-analysis on neonicotinoids and fipronil**
- **Comprehensive approach, including 1221 publications and data from companies**
- **29 scientific authors (no conflict of interest)**
- **Published in *Environmental Science and Pollution Research*, 2015**

Objective : assessment of risks for non target species

Measurement of real exposures
- Plants (including pollen & nectar)
- Soils (behavior and fate)
- Water (surface & ground waters)
- Air (e.g. contaminated dusts)

Measurement of real effects
- Acute dose (e.g. LD50)
- effects by chronic exposure (e.g. 10 days)
- in laboratory
- in semi-field & real field

Risk = real exposure concentration / lowest concentration having toxic effects (LOEC)

Recommendations to authorities for conservation of pollinators, ecosystems & public health

Environ Sci Pollut Res
DOI 10.1007/s11356-014-3332-7

WORLDWIDE INTEGRATED ASSESSMENT OF THE IMPACT OF SYSTEMIC PESTICIDES ON BIODIVERSITY AND ECOSYSTEMS

Environmental fate and exposure; neonicotinoids and fipronil

J.-M. Bonmatin · C. Giorio · V. Girolami · D. Goulson · D. P. Kreutzweiser · C. Krupke · M. Liess · E. Long · M. Marzaro · E. A. D. Mitchell · D. A. Noome · N. Simon-Delso · A. Tapparo

Example of range of contamination worldwide: imidacloprid (mean values):

- **Soils: 1 ng/g - 1000 ng/g**
  (organic farming < 10 pg/g)

- **Ground water: 1 - 100 ng/L**
- **Surface water: 1 - 2000 ng/L**

- **Crops: 1 - 1000 ng/g**
- **Fruits & vegetables: 1 - 100 ng/g**
- **Pollen: 1 - 39 ng/g**
- **Honey: 1 - 73 ng/g**

- **Dead bees: from 0 (metabolized) to 5 ng/g**

Neonicotinoid	DT50 soil (days)	Max (years)
Acetamiprid	1-450	1.5
Clothianidin	148-6900	30
Dinotefuran	75-138	0.5
Imidacloprid	40-1136	5
Thiacloprid	1-27	3
Thiamethoxam	25-100	1

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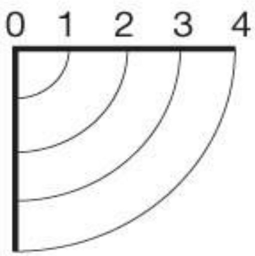
LEGEND

***EXPOSURE**

0: No route of exposure
1: Potential route of exposure assumed negligible
2: Relevant route of exposure low
3: Relevant route of exposure moderate
4: Relevant route of exposure high



Plants
Air
Soil
Water

†ECOTOXICOLOGICAL EFFECT

1: Potential effects assumed negligible under normal exposure conditions
2: Evidence effects can occur but at high doses or after prolonged exposure
3: Evidence effects can occur at moderate doses
4: Evidence effects can occur at low doses or after acute exposure
Unknown: in situations where no judgement could be made because of lack of evidence, e.g. data unavailable
Probable: no accurate judgement could be made due to incomplete evidence, but data suggests a potential effect level above (1)

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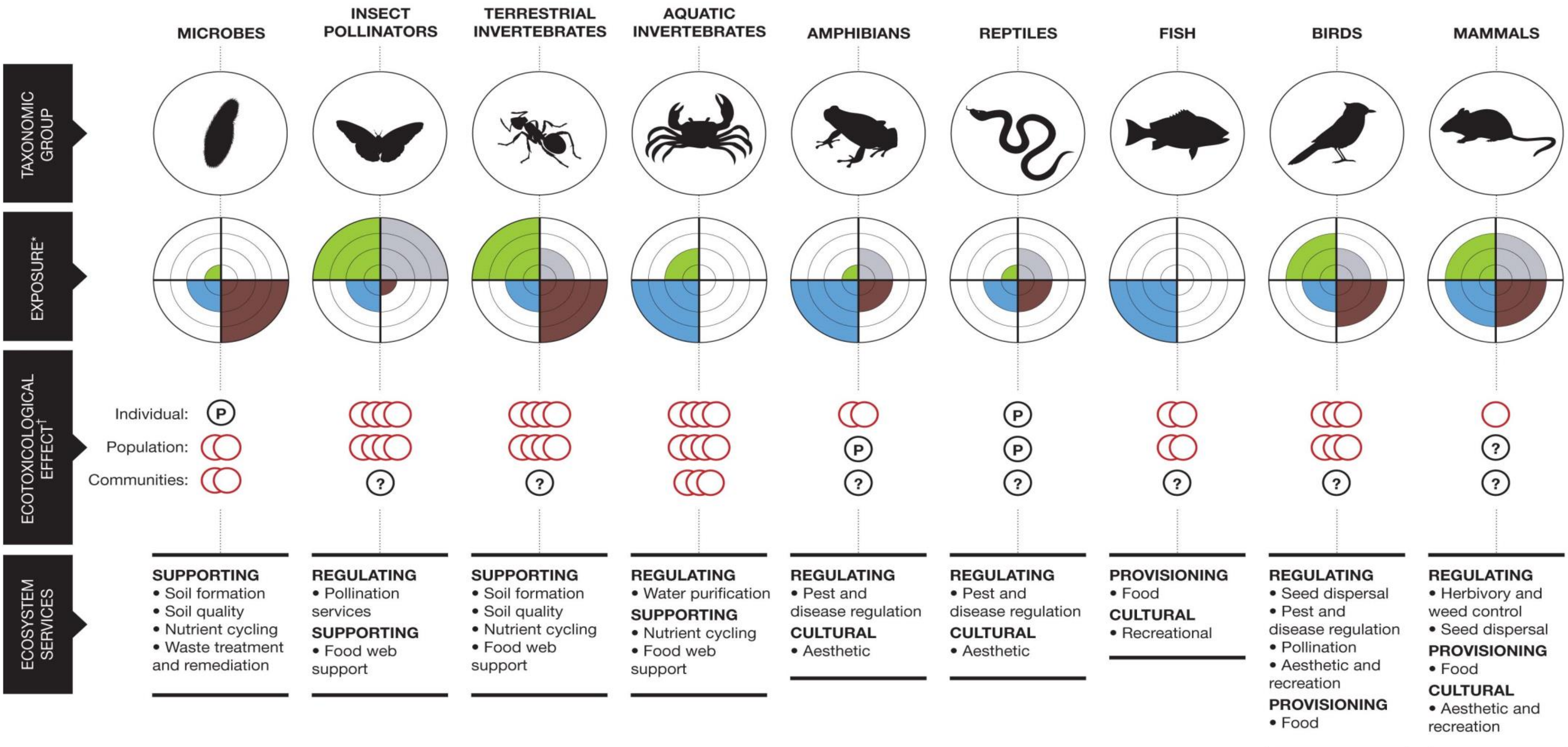

Ecosystem services, agriculture and neonicotinoids

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The Spanish Royal Academy of Sciences
The Royal Swedish Academy of Sciences
The Royal Society (United Kingdom)

The Norwegian Academy of Science and Letters
The Swiss Academies of Arts and Sciences

Critical to assessing the effects of neonicotinoids on ecosystem services is their impact on non-target organisms: both invertebrates and vertebrates, and whether located in the field or margins, or in soils or the aquatic environment. Here, the Expert Group finds the following.

1. There is an increasing body of evidence that the widespread prophylactic use of neonicotinoids has severe negative effects on non-target organisms that provide ecosystem services including pollination and natural pest control.

2. There is clear scientific evidence for sublethal effects of very low levels of neonicotinoids over extended periods on non-target beneficial organisms. These should be addressed in EU approval procedures.

3. Current practice of prophylactic usage of neonicotinoids is inconsistent with the basic principles of integrated pest management as expressed in the EU's Sustainable Pesticides Directive.

4. Widespread use of neonicotinoids (as well as other pesticides) constrains the potential for restoring biodiversity in farmland under the EU's Agri-environment Regulation.

 RESEARCH COMMUNICATIONS

Large-scale trade-off between agricultural intensification and crop pollination services

Nicolas Deguines[1*], Clémentine Jono[1], Mathilde Baude[2,3], Mickaël Henry[4,5], Romain Julliard[1], and Colin Fontaine[1]

Unprecedented growth in human populations has required the intensification of agriculture to enhance crop productivity, but this was achieved at a major cost to biodiversity. There is abundant local-scale evidence that both pollinator diversity and pollination services decrease with increasing agricultural intensification. This raises concerns regarding food security, as two-thirds of the world's major food crops are pollinator-dependent. Whether such local findings scale up and affect crop production over larger scales is still being debated. Here, we analyzed a country-wide dataset of the 54 major crops in France produced over the past two decades and found that benefits of agricultural intensification decrease with increasing pollinator dependence, to the extent that intensification failed to increase the yield of pollinator-dependent crops and decreased the stability of their yield over time. This indicates that benefits from agricultural intensification may be offset by reductions in pollination services, and supports the need for an ecological intensification of agriculture through optimization of ecosystem services.

Front Ecol Environ 2014; 12(4): 212–217, doi:10.1890/130054

Benefits of Neonicotinoid Seed Treatments to Soybean Production

EPA analyzed the use of the neonicotinoid seed treatments for insect control in United States soybean production. This report provides the analysis and EPA's conclusions based on the analysis. It discusses how the treatments are used, available alternatives, and costs.

EPA concludes that these seed treatments provide little or no overall benefits to soybean production in most situations. Published data indicate that in most cases there is no difference in soybean yield when soybean seed was treated with neonicotinoids versus not receiving any insect control treatment.

The public comment period on the analysis is open until December 22, 2014.

Visit the docket to submit a comment. (Use the "Comment Now" button on the right side of the page.)

Read the benefits analysis:

- Benefits of Neonicotinoid Seed Treatment to Soybean Production (PDF) (18 pp, 12 MB)

You will need Adobe Reader to view some of the files on this page. See EPA's About PDF page to learn more.

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J Pest Sci
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ORIGINAL PAPER

Imidacloprid-mediated effects on survival and fertility of the Neotropical brown stink bug *Euschistus heros*

M. F. Santos[1] · R. L. Santos[2] · H. V. V. Tomé[1] · W. F. Barbosa[1,3] · G. F. Martins[4] · R. N. C. Guedes[1] · E. E. Oliveira[1]

Abstract Enhanced reproductive output after sublethal insecticide exposure, including neonicotinoid exposure, has been reported in a diversity of arthropods. Suspicions of such a phenomenon in the Neotropical brown stink bug, *Euschistus heros* (Hemiptera: Pentatomidae), were sparked by the increasing densities of naturally occurring populations of this insect pest species in Brazilian soybean fields. Here, we tested whether the sublethal exposure to imidacloprid would induce changes in the survival and reproductive performances of *E. heros* adult females. The imidacloprid estimated LC_{50} was 0.83 (0.60–1.25) μg a.i./cm^2, and the dose recommended for field applications (4.2 μg a.i./cm^2) was within the concentration range of the imidacloprid estimated LC_{80} [2.66 (1.65–5.49) μg a.i./cm^2]. Newly emerged ($\leq$24 h) adult females were exposed for 48 h to dry imidacloprid residues (0.042 μg/cm^2, equivalent to 1 % of the field rate dose) and exhibited higher levels of cell damage, greater ovariole length, and a larger area of the most developed follicle in their ovaries up to the 6th day of adulthood. Furthermore, these females exhibited reduced rates of survival but higher fecundity and fertility rates compared with untreated females. Our results thus suggest that females of *E. heros* increased their reproductive output in response to the imidacloprid sublethal exposure. These findings suggest a potential involvement of sublethal exposure to neonicotinoids in the recent outbreaks of the Neotropical brown stink bug *E. heros* observed in Brazilian soybean-producing regions.

Keywords Reproductive responses · Hormesis · Insect ovaries · Damaged cells · Stink bugs

Key message

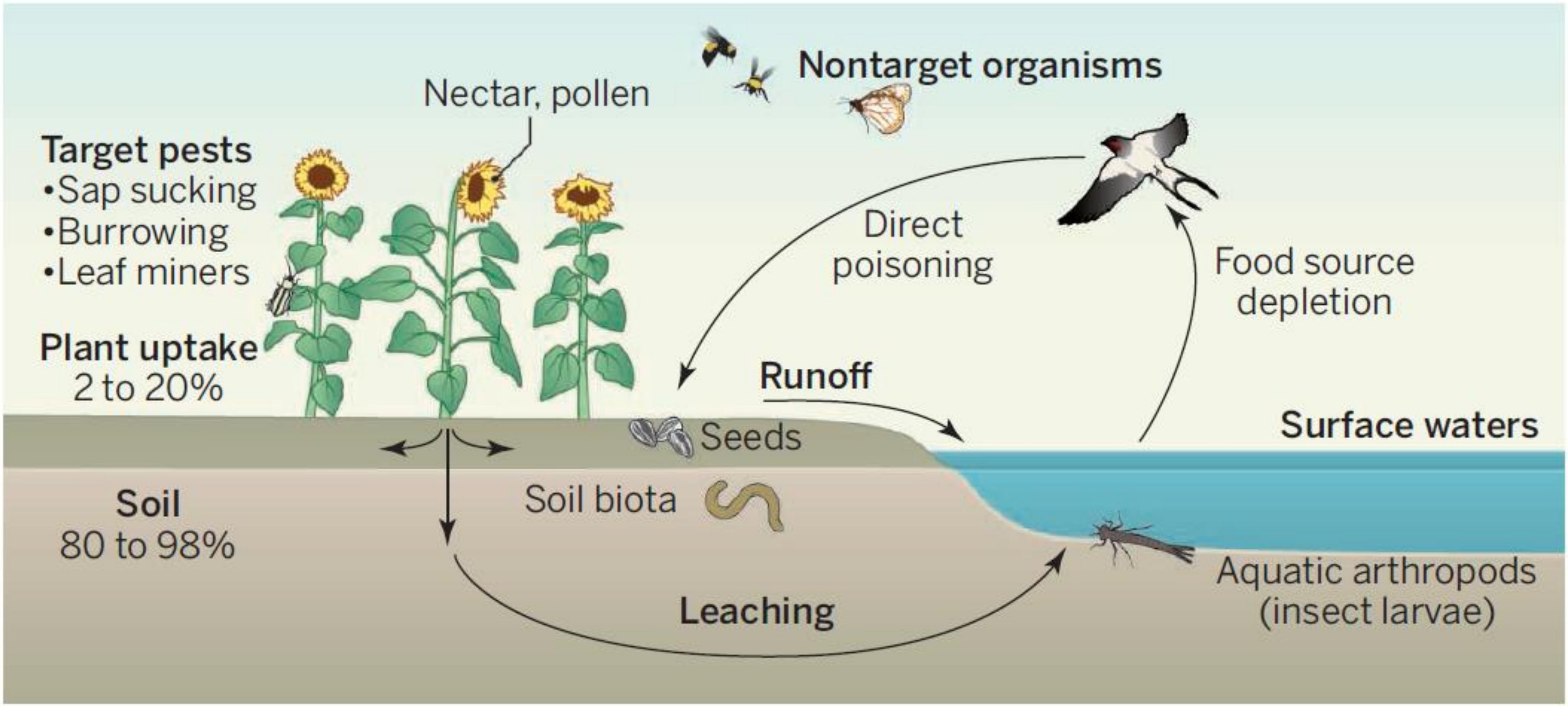
- Insecticide-induced changes in *Euschistus heros* reproduction capacity has been sparked by the increasing densities of this pest in Brazilian soybean fields.
- Females of *E. heros* increased their reproductive output (fecundity and fertility rates) to overcome imidacloprid-induced sublethal stress (higher number of damaged ovarian cells and reduction on female's survival).
- These findings suggest a potential link between imidacloprid sublethal exposure and the recent outbreaks of *E. heros* observed in the Brazilian soybean fields.

Communicated by E. Roditakis.

The trouble with neonicotinoids

Chronic exposure to widely used insecticides kills bees and many other invertebrates

806 14 NOVEMBER 2014 • VOL 346 ISSUE 6211 *By* **Francisco Sánchez-Bayo** sciencemag.org SCIENCE



Fate of neonicotinoids and pathways of environmental contamination.

Environ Sci Pollut Res
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EDITORIAL

Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning

J. P. van der Sluijs · V. Amaral-Rogers · L. P. Belzunces · M. F. I. J. Bijleveld van Lexmond · J-M. Bonmatin · M. Chagnon · C. A. Downs · L. Furlan · D. W. Gibbons · C. Giorio · V. Girolami · D. Goulson · D. P. Kreutzweiser · C. Krupke · M. Liess · E. Long · M. McField · P. Mineau · E. A. D. Mitchell · C. A. Morrissey · D. A. Noome · L. Pisa · J. Settele · N. Simon-Delso · J. D. Stark · A. Tapparo · H. Van Dyck · J. van Praagh · P. R. Whitehorn · M. Wiemers

- **Preventive and massive uses**
- **Extreme toxicity to invertebrates**
- **High toxicity to vertebrates**
- **Very high persistence in soils**
- **High contamination of water (surface & groundwater)**

→

- ✓**Collapse of pollinators & biodiversity**
- ✓**Effects on ecosystem services**
- ✓**Threats on food production & food security**
- ✓**Threats on human health**

↓

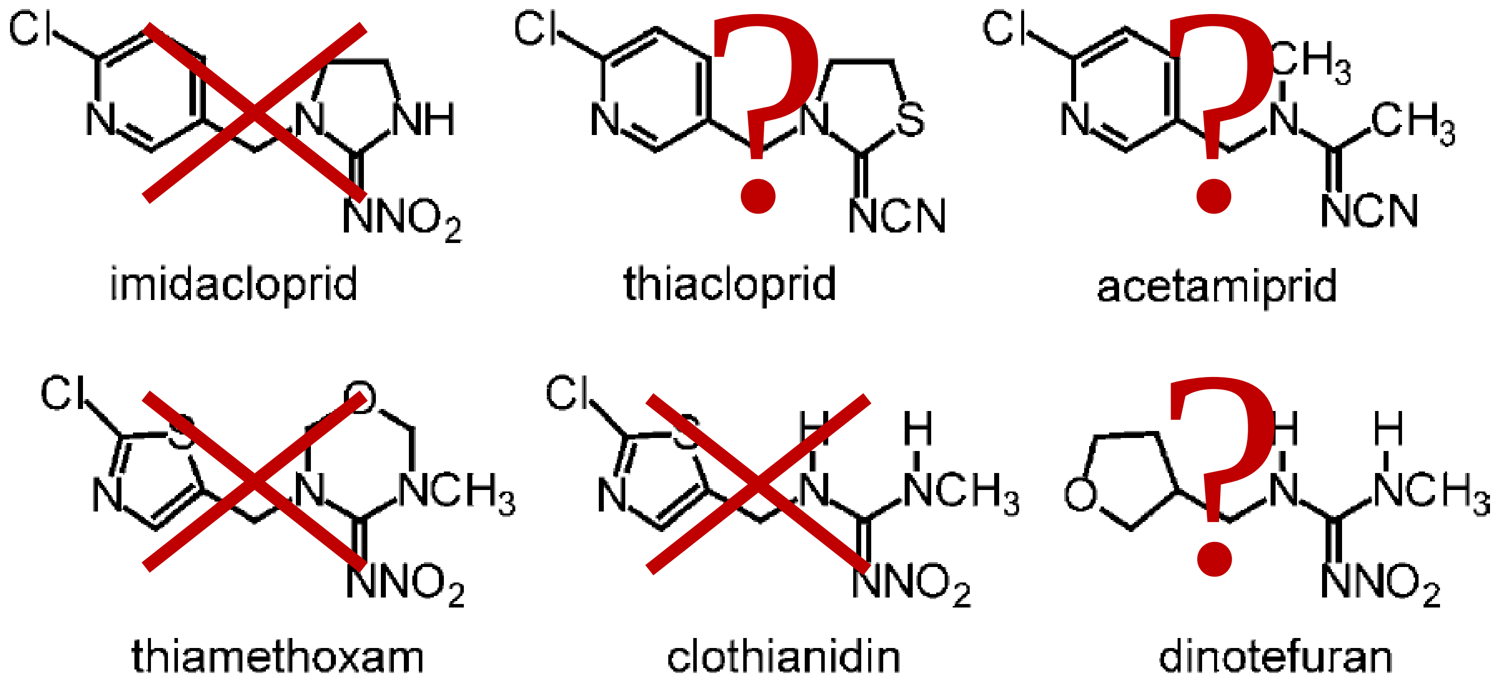
The present use of systemic insecticides is not sustainable
=> Reduce or suspend => Integrated pest management (IPM)

COMMISSION IMPLEMENTING REGULATION (EU) No 485/2013

of 24 May 2013

amending Implementing Regulation (EU) No 540/2011, as regards the conditions of approval of the active substances clothianidin, thiamethoxam and imidacloprid, and prohibiting the use and sale of seeds treated with plant protection products containing those active substances

Neonicotinoids



2013-2015: No reduction of yields for crop production in UE

Ministère de l'Écologie, du Développement durable et de l'Énergie

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

New French law on biodiversity

Ségolène ROYAL
Ministre de l'Écologie, du Développement durable et de l'Énergie

Abeilles et pollinisateurs sauvages
Actions du projet de loi pour la reconquête de la biodiversité, de la nature et des paysages

biodiversité

Communication en Conseil des Ministres
Mercredi 20 mai 2015

http://www.developpement-durable.gouv.fr/IMG/pdf/2015-05-20_DP_Abeilles.pdf

Les actions d'accompagnement du projet de loi :

- **La France engage la démarche d'extension du moratoire européen sur l'ensemble des pesticides néonicotinoides.**

Le rapport du Conseil européen des académies des sciences d'avril 2015 conclut aux sévères effets négatifs des pesticides néonicotinoides sur la faune, l'eau et les sols. Certaines publications montrent une neurotoxicité pour l'homme.

The EASAC report (April 2015) concludes on the severe negative effects of neonicotinoid pesticides on fauna, water and soils.
Some publications show a neurotoxicity for Humans.

Exposure (intake by food)

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

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Article

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Open Access on 06/16/2015

Quantitative Analysis of Neonicotinoid Insecticide Residues in Foods: Implication for Dietary Exposures

Mei Chen,[†] Lin Tao,[†] John McLean,[§] and Chensheng Lu[*,†]

USA 2015:
100% fruits & vegetable samples contained at least 1 neonicotinoid
72% of fruits contained at least 2 neonicotinoids
45% of vegetables contained at least 2 neonicotinoids

Exposure (detoxication by urine)

Advance Publication

Journal of Occupational Health

Accepted for Publication: Aug 7, 2014

Title: Biological Monitoring Method for Urinary Neonicotinoid Insecticides Using LC-MS/MS and Its Application to Japanese Adults

Running title: *Biological monitoring of neonicotinoids in Japanese adults*

Jun Ueyama[a,*], Hiroshi Nomura[a], Takaaki Kondo[a], Isao Saito[b], Yuki Ito[c] Aya Osaka[a] and Michihiro Kamijima[c]

Japan 2014:
90 % of individuals were positive for at least 4 neonicotinoids (imidacloprid, clothianidin, dinotefuran & thiacloprid)

Public health (effects)

- **2007 (ARLA): Potential endocrine disruptors**
- **2012-2014: Genotoxic and cytotoxic**
- **2013 (ANSES): Carcinogen**
- **2013 (EFSA): Neuro-developmental effects**
- **2014: Hepatic effects**
- **2014: Effects on thyroid & testicles**
- **2014: Synergies with other pesticides**
- **2014 (Japan): sub-acute effects on poisoned people (hospital)**
- **2015: Act also on glutamate receptors (new toxic pathway)**


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dépasser les frontières
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Many thanks to all my collaborators and thank you for your attention
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sous l'égide de la Fondation de France