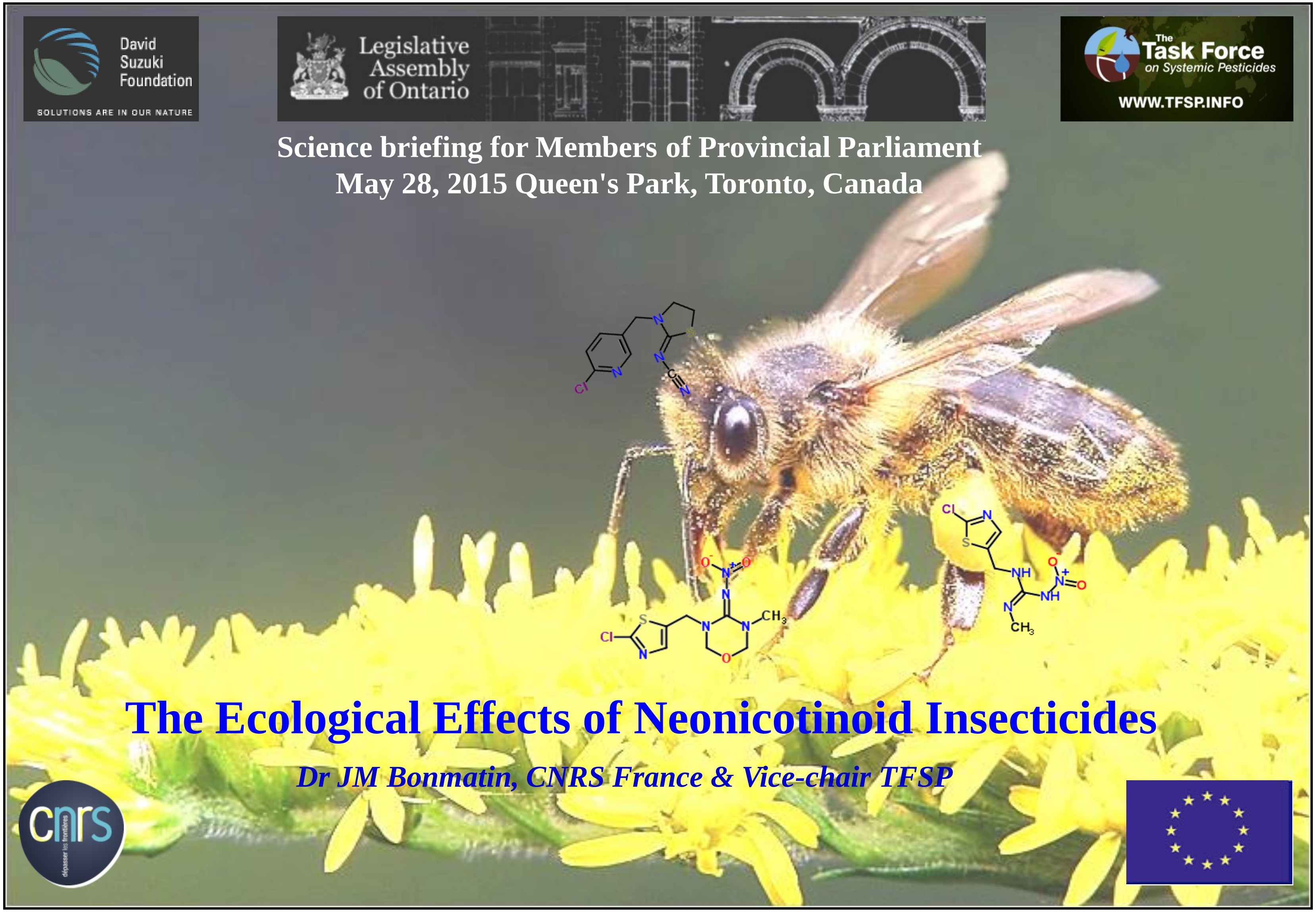
David Suzuki Foundation
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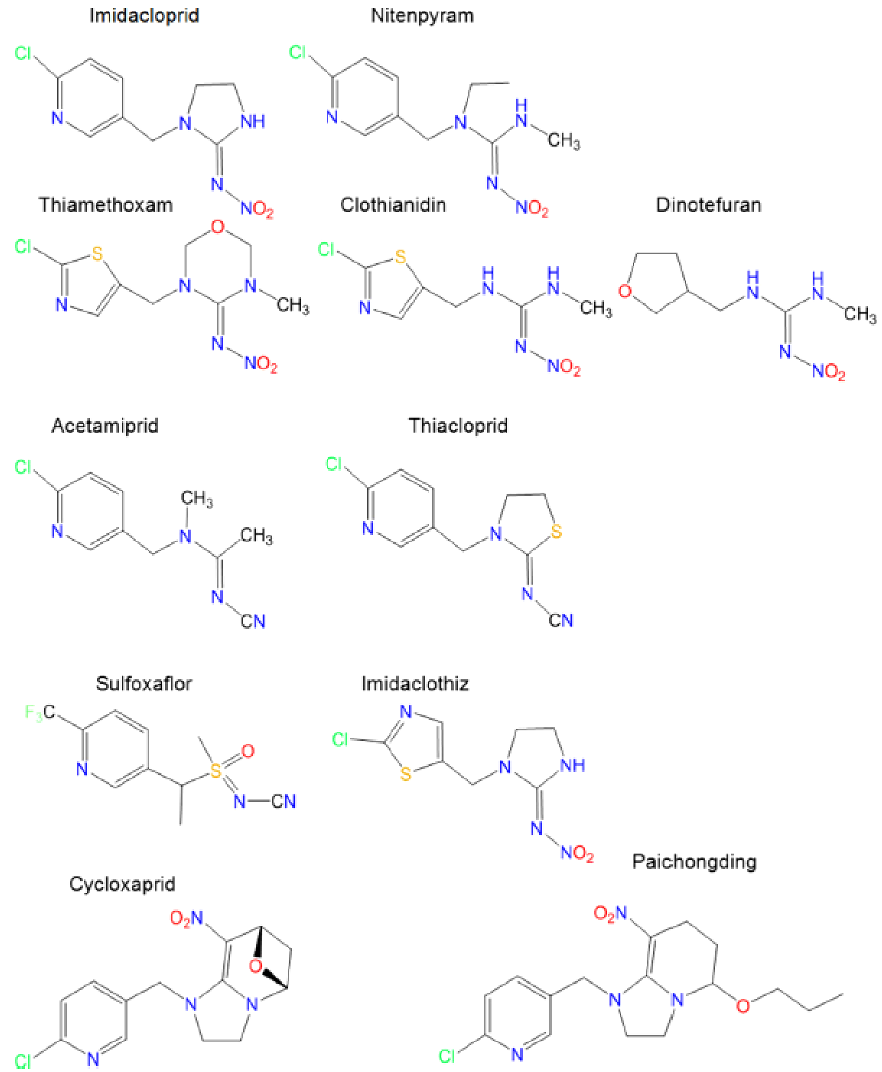
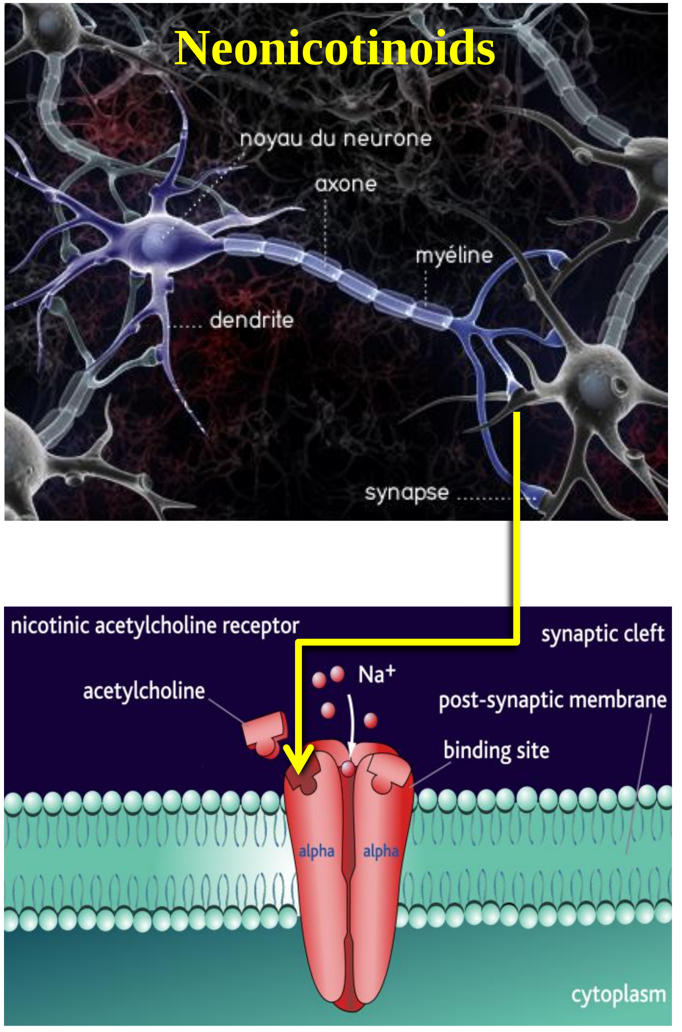
Legislative Assembly of Ontario
The Task Force on Systemic Pesticides
WWW.TFSP.INFO
Science briefing for Members of Provincial Parliament
May 28, 2015 Queen's Park, Toronto, Canada
The Ecological Effects of Neonicotinoid Insecticides
Dr JM Bonmatin, CNRS France & Vice-chair TFSP
cnrs





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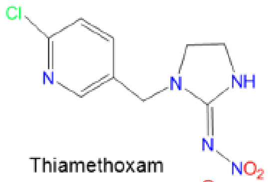
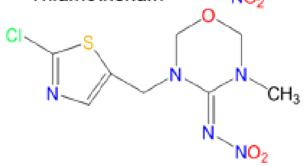
2

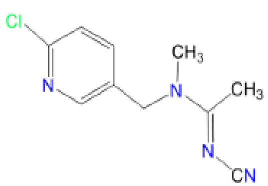
Imidacloprid



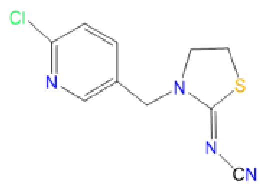
Thiamethoxam

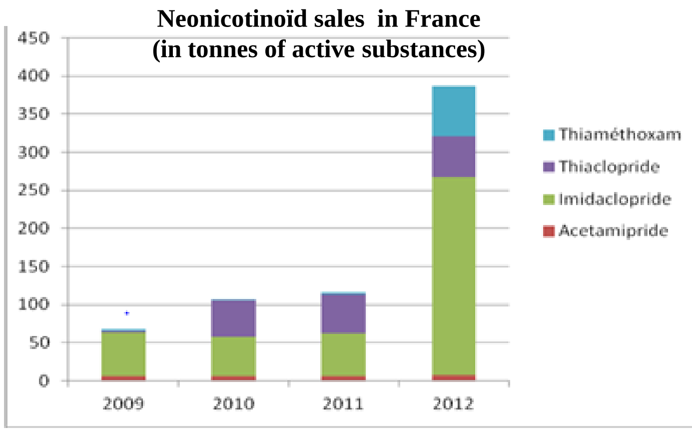


Acetamiprid



Thiacloprid

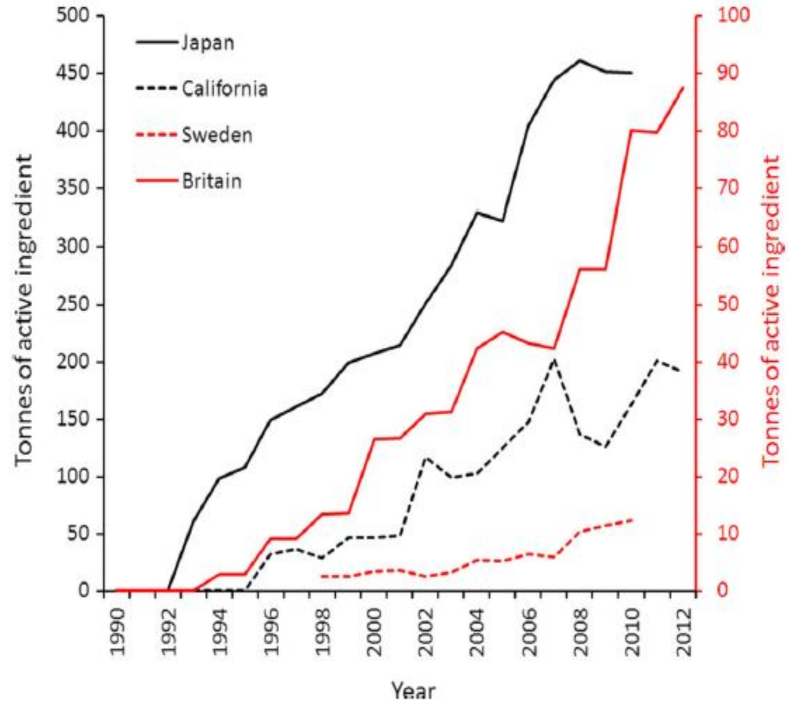




Environ Sci Pollut Res
DOI 10.1007/s11356-014-3470-y

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

Systemic insecticides (neonicotinoids and fipronil): trends, uses, mode of action and metabolites



Dr. JM Bonmatin (CNRS) France

Acute toxicity on 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

Dr. JM Bonmatin (CNRS) France

Environmental Science & Technology
Article
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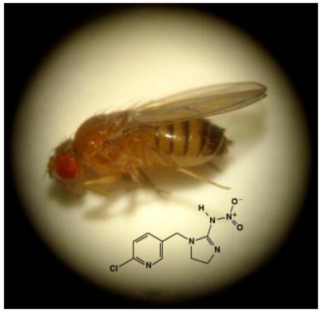
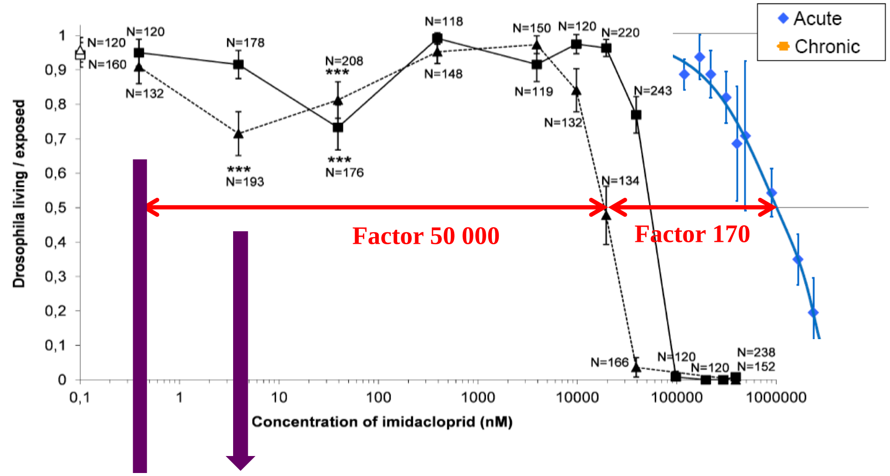
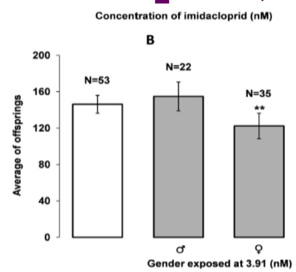
Lethal and Sublethal Effects of Imidacloprid, After Chronic Exposure, On the Insect Model *Drosophila melanogaster*

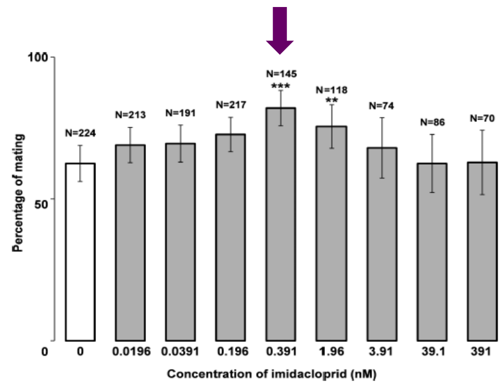
Gaël Charpentier,[†] Fanny Louat,[†] Jean-Marc Bonmatin,[*,†] Patrice A. Marchand,[†] Fanny Vanier,[†] Daniel Locker,[†,‡] and Martine Decoville[†,‡]







Fecondity –16%



Mating +30 %

Chronic LOEC (0,1 ng/g)

♂ acute LC50 / 3 300 000

♀ acute LC50 / 8 600 000

Dr. JM Bonmatin (CNRS) France

Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production

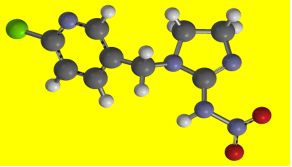
Penelope R. Whitehorn,[1] Stephanie O'Connor,[1] Felix L. Wackers,[2] Dave Goulson[1]*

Growing evidence for declines in bee populations has caused great concern because of the valuable ecosystem services they provide. Neonicotinoid insecticides have been implicated in these declines because they occur at trace levels in the nectar and pollen of crop plants. We exposed colonies of the bumble bee *Bombus terrestris* in the laboratory 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 with 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.

Bees in agroecosystems survive by feeding on wildflowers growing in field margins and patches of seminatural habitat, supplemented by the brief gluts of flowers provided by mass flowering crops such as oilseed rape and sunflower (*1*, *2*). Many crops are now routinely treated with neonicotinoid insecticides. Systemic spreads to the nectar and pollen of flowering crops, typically at concentrations ranging from 0.7 to 10 μg kg^{-1}(*4*, *5*). Thus bee colonies in agroecosystems will be exposed to 2- to 4-week pulses of exposure to neonicotinoids during the flowering period of crops (*6*).

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 randomly allocated to one of three treatments. Control colonies received ad libitum (ad lib) pollen and sugar water over a period of 14 days in the laboratory. Over the same period, colonies in the "low" treatment were fed pollen and sugar water containing 6 μg kg^{-1} and 0.7 μg kg^{-1} imidacloprid, respectively, representing the levels found in seed-treated rape (*13*). The "high"-treatment colonies received double these doses, still close to the field-realistic range. After 2 weeks, all colonies were then placed in the field, where they were left to forage independently for a period of 6 weeks while their performance was monitored.

All colonies experienced initial weight gain followed by a decline as they switched from their growth phase to producing new reproductives. Colonies in both low and high treatments gained less weight over the course of



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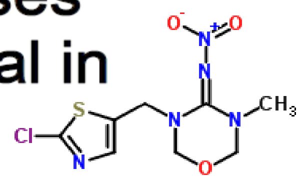
A Common Pesticide Decreases Foraging Success and Survival in Honey Bees



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.

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-

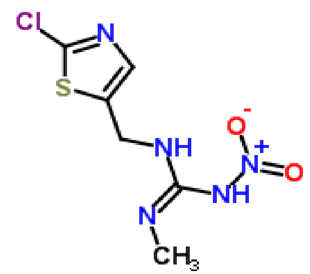
Neonicotinoid clothianidin adversely affects insect immunity and promotes replication of a viral pathogen in honey bees

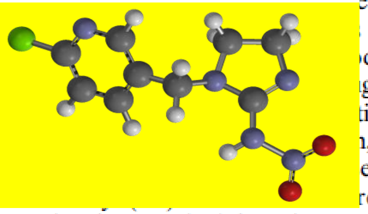
Gennaro Di Prisco[a], Valeria Cavaliere[b], Desiderato Annoscia[c], Paola Varricchio[a], Emilio Caprio[a], Francesco Nazzi[c], Giuseppe Gargiulo[b], and Francesco Pennacchio[a,1]

[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





ıicotinoid insecticides are cur-
ɔate (13). Over the last few years,
l their use in agriculture, and they
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ently, three of them have been
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ıce regarding the negative effects
n shown that sublethal doses of
homing capacity of honey bees
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ave provided further confirma-
eonicotinoids can have a wider
(19, 20). Importantly, exposure
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gh the merely descriptive results
ing and do not support any clear
ı, due to significant gaps in our
e insecticides act on honey bee
ress this issue, focusing on the
mechanism underlying the presumed immunosuppressive ac-

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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
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Conclusion
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Citation: Vidau
Honeybees Previ
Editor: Elizabeth
Received March

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Environmental Microbiology (2014) doi:10.1111/1462-2920.12426

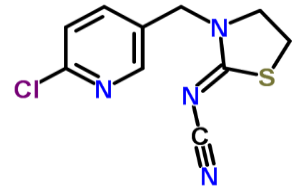
Bees under stress: sublethal doses of a neonicotinoid pesticide and pathogens interact to elevate honey bee mortality across the life cycle

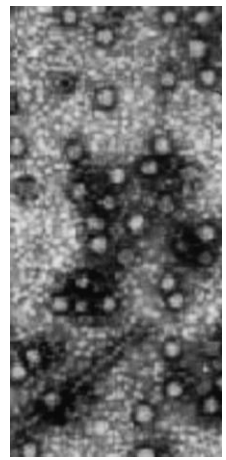
Vincent Doublet,[1*†] Maureen Labarussias,[1] Joachim R. de Miranda,[2] Robin F. A. Moritz[1,3] and Robert J. Paxton[1,3,4]

bee
as t
surv

Thiacloprid + nosema

Thiacloprid + BQCV



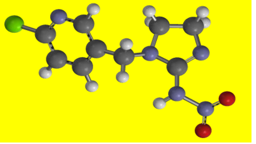


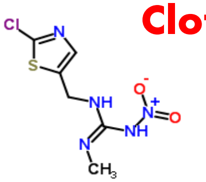
Bulletin of Insectology **67** (1): 125-130, 2014
ISSN 1721-8861

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-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

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.

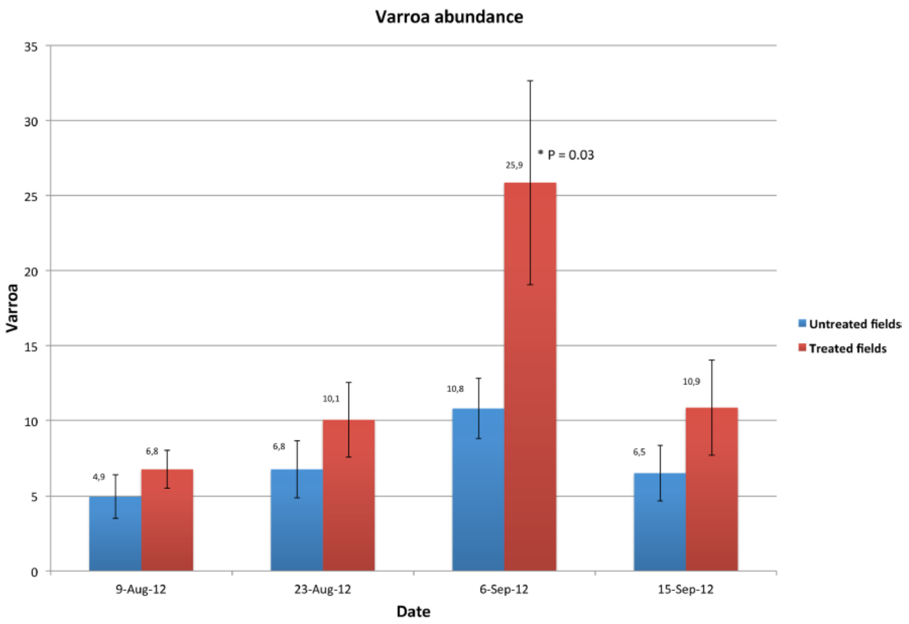
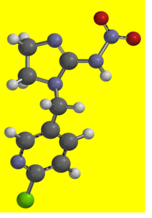


Fig 4. Mean values of varroa mite abundance in the 32 studied colonies, 16 colonies in each treated and untreated cornfields on four different dates. Error bars are the Standard Errors (SE) of each studied group. P values is * P < 0.05.



Dr. JM Bonmatin (CNRS) France

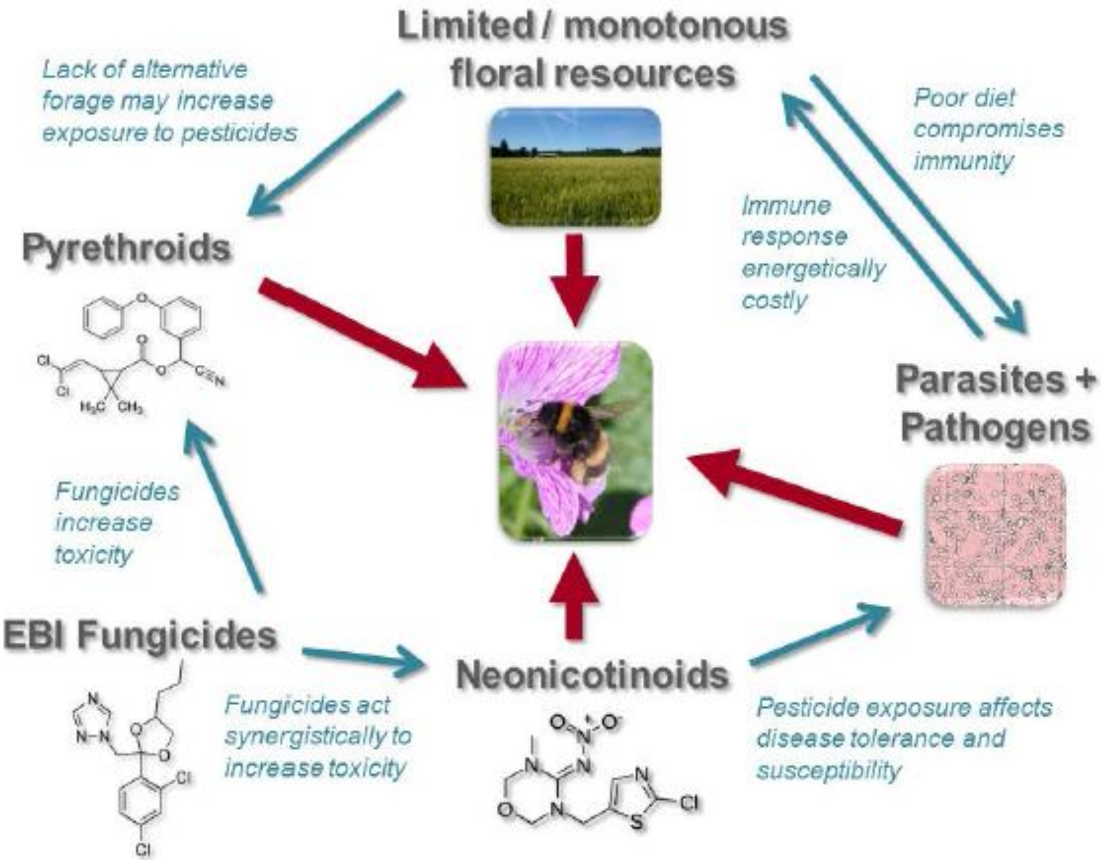
Bee declines driven by combined stress from parasites, pesticides, and lack of flowers

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



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

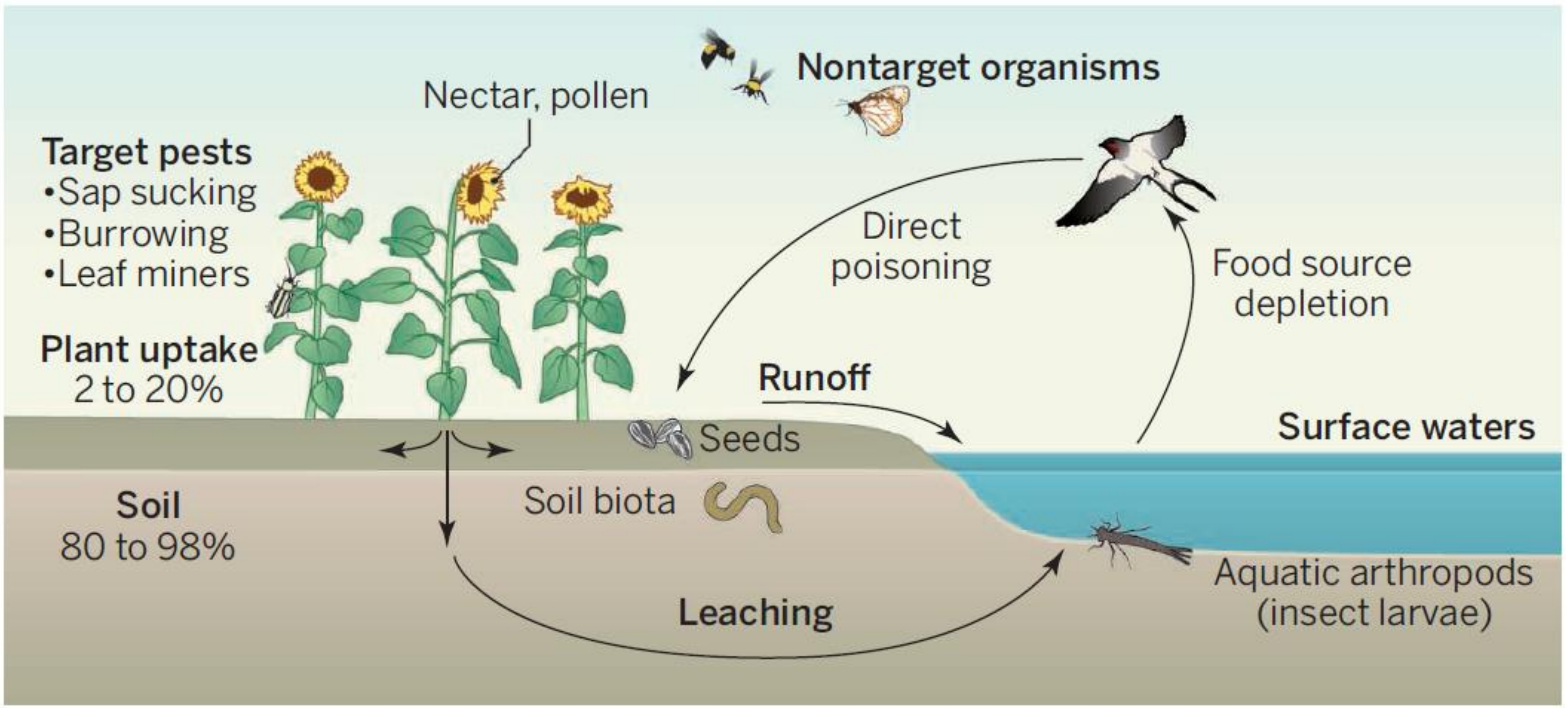
- Improve the advice to farmers, landowners, managers of public and amenity spaces and gardeners on best practices for using insecticides. This should draw upon research evidence to provide guidance which takes into account the diverse life histories of European bees and other pollinators.
- Commit to 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).

13

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
DOI 10.1007/s11356-014-3220-1

EDITORIAL

The Task Force on Systemic Pesticides
WWW.TFSP.INFO

Worldwide integrated assessment on systemic pesticides

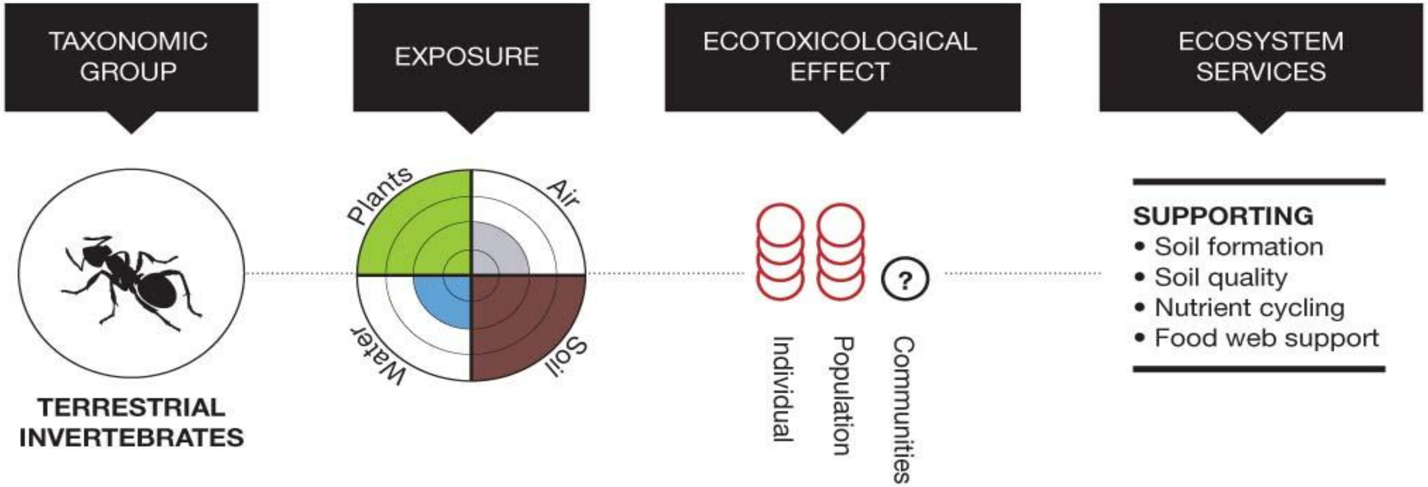
Global collapse of the entomofauna: exploring the role of systemic insecticides

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

8 scientific articles

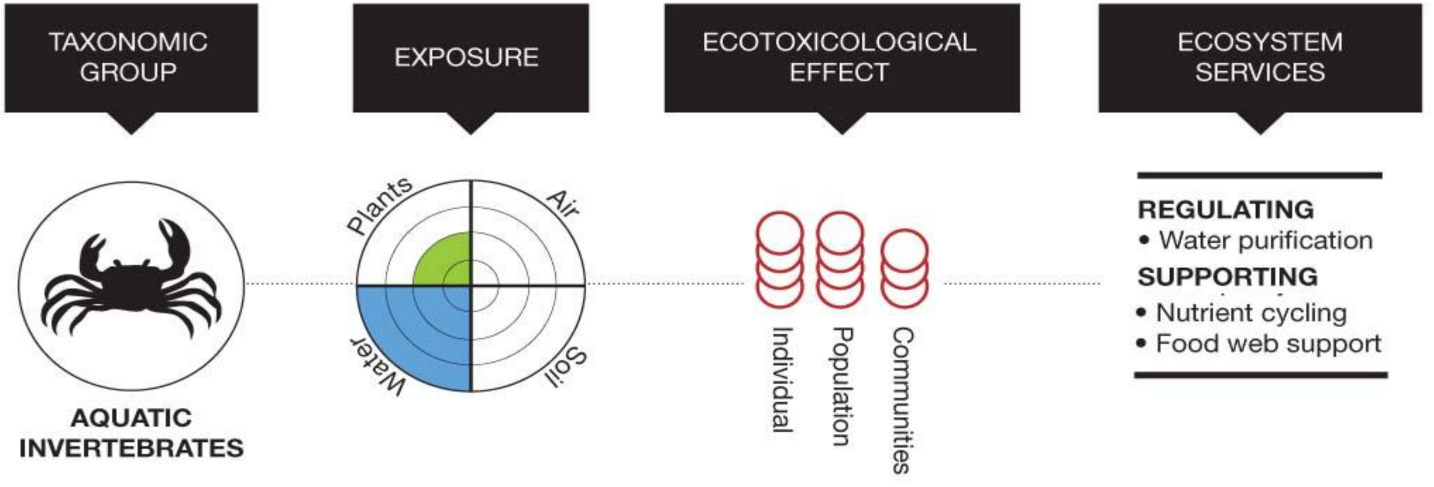
- **First meta-analysis on neonicotinoids and fipronil**
- **Comprehensive approach, including 1221 publications and data from compagnies**
- **29 scientific authors (no conflict of interest)**
- **Published in *Environmental Science and Pollution Research*, 2015**

TERRESTRIAL INVERTEBRATES

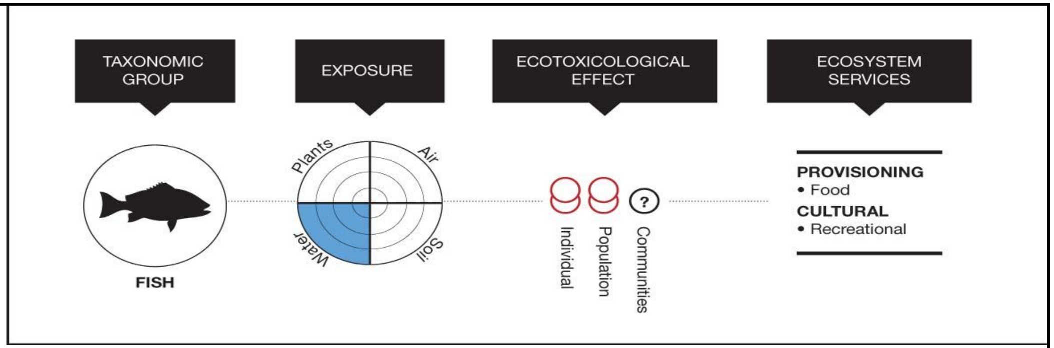


Dr. JM Bonmatin (CNRS) France

AQUATIC INVERTEBRATES



FISHES



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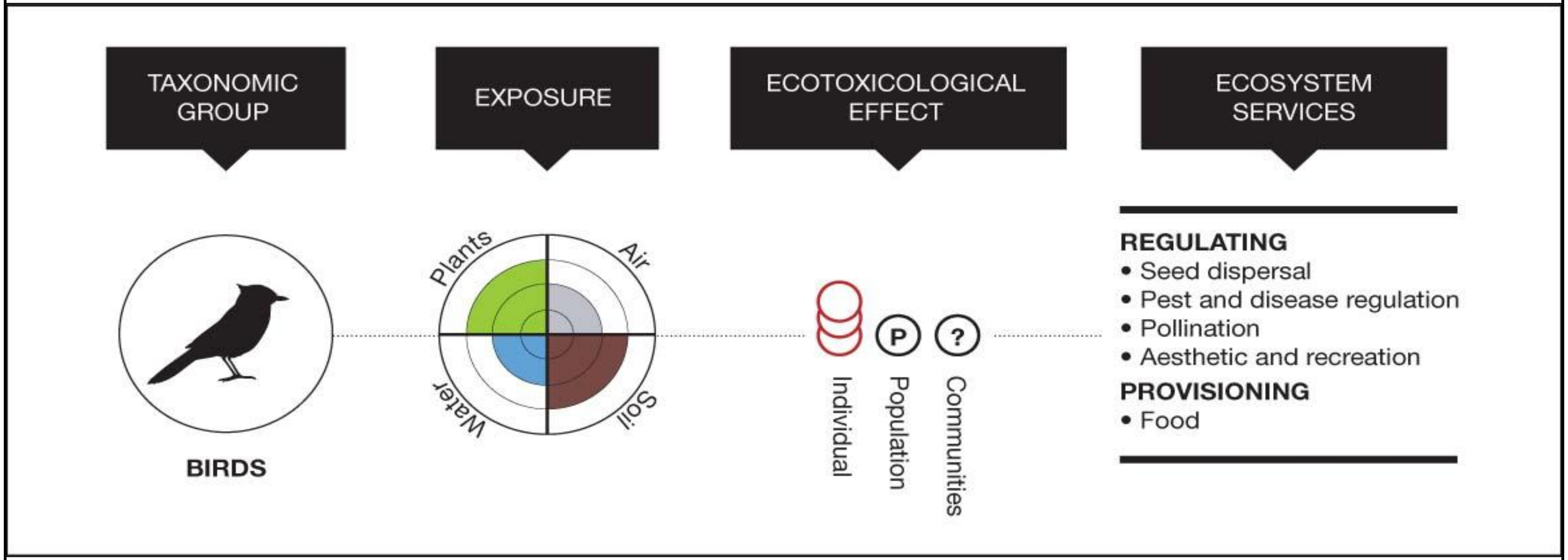

doi:10.1038/nature13531

Declines in insectivorous birds are associated with high neonicotinoid concentrations

Caspar A. Hallmann[1,2], Ruud P. B. Foppen[2,3], Chris A. M. van Turnhout[2], Hans de Kroon[1] & Eelke Jongejans[1]

Recent studies have shown that neonicotinoid insecticides have adverse effects on non-target invertebrate species[1–6]. Invertebrates constitute a substantial part of the diet of many bird species during the breeding season and are indispensable for raising offspring[7]. We investigated the hypothesis that the most widely used neonicotinoid insecticide, imidacloprid, has a negative impact on insectivorous bird populations. Here we show that, in the Netherlands, local population trends were significantly more negative in areas with higher surface-water concentrations of imidacloprid. At imidacloprid concentrations of more than 20 nanograms per litre, bird populations tended to decline by 3.5 per cent on average annually. Additional analyses revealed that this spatial pattern of decline appeared only after the introduction of imidacloprid to the Netherlands, in the mid-1990s. We further show that the recent negative relationship remains after correcting for spatial differences in land-use changes that are known to affect bird populations in farmland. Our results suggest that the impact of neonicotinoids on the natural environment is even more substantial than has recently been reported and is reminiscent of the effects of persistent insecticides in the past. Future legislation should take into account the potential cascading effects of neonicotinoids on ecosystems.

The present study takes advantage of two standardized, long-term, country-wide monitoring schemes in the Netherlands (see Methods)—the Dutch Common Breeding Bird Monitoring Scheme[17] and surface-water quality measurements[4]—to investigate the extent to which average concentrations of imidacloprid residues in the period 2003–2009 spatially correlate with bird population trends in the period 2003–2010. We selected 15 passerine species that are common in farmlands and depend on invertebrates during the breeding season (Extended Data Table 1 and Supplementary Methods). We interpolated concentrations of imidacloprid in surface water to bird monitoring plots (Extended Data Figs 1–3, Supplementary Data and Supplementary Methods) and examined how local bird trends correlate with these concentrations (Fig. 1).

The average intrinsic rate of increase in local farmland bird populations was negatively affected by the concentration of imidacloprid (Fig. 1b, linear mixed effects regression (LMER): d.f. = 1,443, $t = -5.64$, $P < 0.0001$). At the separately tested individual species level, 14 out of 15 of the tested species had a negative response to interpolated imidacloprid concentrations, and 6 out of 15 had a significant negative response at the 95% confidence level after Bonferroni correction (Table 1 and Extended Data Fig. 4). Thus, higher concentrations of imidacloprid in surface water in

Ecosystem services, agriculture and neonicotinoids

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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.

EPA United States Environmental Protection Agency

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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)

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Dr. JM Bonmatin (CNRS) France

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 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.

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J Pest Sci
DOI 10.1007/s10340-015-0666-y

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 (≤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.

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JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Article

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

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ABSTRACT: This study quantitatively measured neonicotinoids in various foods that are common to human consumption. All fruit and vegetable samples (except nectarine and tomato) and 90% of honey samples were detected positive for at least one neonicotinoid; 72% of fruits, 45% of vegetables, and 50% of honey samples contained at least two different neonicotinoids in one sample, with imidacloprid having the highest detection rate among all samples. All pollen samples from New Zealand contained multiple neonicotinoids, and five of seven pollens from Massachusetts detected positive for imidacloprid. These results show the prevalence of low-level neonicotinoid residues in fruits, vegetables, and honey that are readily available in the market for human consumption and in the environment where honeybees forage. In light of new reports of toxicological effects in mammals, the results strengthen the importance of assessing dietary neonicotinoid intakes and the potential human health effects.

KEYWORDS: *neonicotinoid insecticides, dietary exposure, pollen, honey*

Neonicotinoids and public health

- Neonics are less toxic to humans (less nicotinic receptors for our CNS)
- Only few studies (despite that neonics represent 1/3 of the global insecticide market):

(non-target species > 1000 publications ; humans < 20 publications)

BUT

- **EPA 2002 then UE then ANSES (2013): Thiacloprid carcinogen**
- **ARLA 2001, 2004, 2007: Three neonics are potential endocrine disruptors**
- **2012: Genotoxicity and cytotoxicity of neonics**
- **2012: Neonics have similar effects than nicotine**
- **EFSA 2013: Neuro-developmental risk for humans**
- **2014: Effects on hepatic enzymes (toxic accumulation of delta-ALA)**
- **2014: Cytotoxic effects of formulations >> active ingredients, on human cells**
- **2014: Effects on thyroid and testicles (endocrine disruptor)**
- **2014: Synergies with other pesticides (pyrethroid and carbamate)**
- **Japan 2014: description of sub-acute effects on poisoned people (hospital)**
- **Japan 2014 & 2015: human urine contains neonics (90% of tested people)**
- **2015: Another new toxic pathway of neonics on the CNS (glutamate receptors)…**

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 use**
- **Very high toxicity to invertebrates**
- **High toxicity to vertebrates**
- **Very high persistence in soils**
- **High contamination of water (surface & groundwater)**

→

- ✓**Collapse of pollinators & biodiversity**
- ✓**Threats on ecosystem stability**
- ✓**Threats on food production & food security**

↓

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

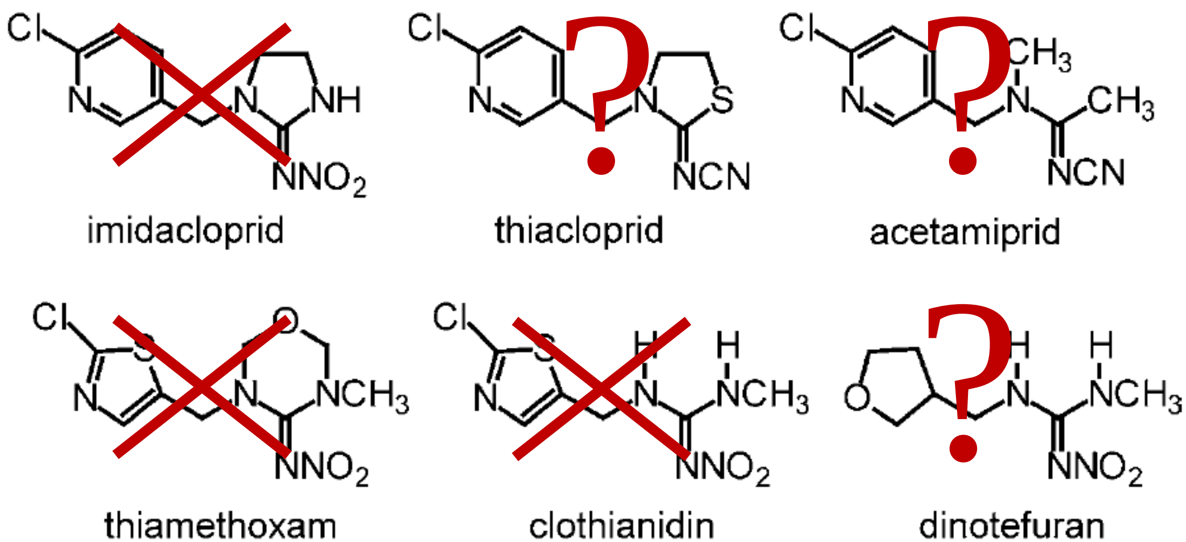
L 139/12 EN Official Journal of the European Union 25.5.2013

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

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

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

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

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.

Communication en Conseil des Ministres
Mercredi 20 mai 2015

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Thanks to my colleagues, to all my collaborators,

… and thank you for your attention.

Exposure to Clothianidin Seed-Treated Canola Has No Long-Term Impact on Honey Bees

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J. Econ. Entomol. 100(3): 765–772 (2007)

ABSTRACT We conducted a long-term investigation to ascertain effects on honey bee, *Apis mellifera* L., colonies during and after exposure to flowering canola, *Brassica napus* variety Hyola 420, grown from clothianidin-treated seed. Colonies were placed in the middle of 1-ha clothianidin seed-treated or control canola fields for 3 wk during bloom, and thereafter they were moved to a fall apiary. There were four treated and four control fields, and four colonies per field, giving 32 colonies total. Bee mortality, worker longevity, and brood development were regularly assessed in each colony for 130 d from initial exposure to canola. Samples of honey, beeswax, pollen, and nectar were regularly collected for 130 d, and the samples were analyzed for clothianidin residues by using high-performance liquid chromatography with tandem mass spectrometry detection. Overall, no differences in bee mortality, worker longevity, or brood development occurred between control and treatment groups throughout the study. Weight gains of and honey yields from colonies in treated fields were not significantly different from those in control fields. Although clothianidin residues were detected in honey, nectar, and pollen from colonies in clothianidin-treated fields, maximum concentrations detected were 8- to 22-fold below the reported no observable adverse effects concentration. Clothianidin residues were not detected in any beeswax sample. Assessment of overwintered colonies in spring found no differences in those originally exposed to treated or control canola. The results show that honey bee colonies will, in the long-term, be unaffected by exposure to clothianidin seed-treated canola.

Acknowledgments

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VS

RESEARCH ARTICLE

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

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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.

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

Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions

March 2013




Authors: Helen Thompson, Paul Harrington, Selwyn Wilkins, Stephane Pietravalle, Dinah Sweet and Ainsley Jones

Food and Environment Research Agency, Sand Hutton, York YO41 1LZ

Using the observed variation in neonicotinoid residues across colonies within and between sites, possible correlations with colony mass and the number of new queens produced were explored. No clear consistent relationships were observed.

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vs

EFSA JOURNAL

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Evaluation of the FERA study on bumble bees and consideration of its potential impact on the EFSA conclusions on neonicotinoids

EFSA Journal 2013;11(6):3242[20 pp.]. doi:10.2903/j.efsa.2013.3242

Subsc
to the

Overall, EFSA considered that the study is not adequate to understand the effects of exposure of neonicotinoid residues on bumble bee colonies. EFSA also concluded that the study by Thompson *et al.* (2013) does not change the conclusions of the risk assessment previously drawn for thiamethoxam, clothianidin and imidacloprid in the EFSA Conclusions published in January 2013 (EFSA 2013a, EFSA 2013b and EFSA 2013c).

and

doi:10.1038/nature14420

Seed coating with a neonicotinoid insecticide negatively affects wild bees

Maj Rundlöf[1], Georg K. S. Andersson[1,2], Riccardo Bommarco[3], Ingemar Fries[3], Veronica Hederström[1], Lina Herbertsson[2], Ove Jonsson[4,5], Björn K. Klatt[2], Thorsten R. Pedersen[6], Johanna Yourstone[1] & Henrik G. Smith[1,2]

and

Neonicotinoids impact bumblebee colony fitness in the field; a reanalysis of the UK's Food & Environment Research Agency 2012 experiment

Dave Goulson

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ABSTRACT

The causes of bee declines remain hotly debated, particularly the contribution of neonicotinoid insecticides. In 2013 the UK's Food & Environment Research Agency made public a study of the impacts of exposure of bumblebee colonies to neonicotinoids. The study concluded that there was no clear relationship between colony performance and pesticide exposure, and the study was subsequently cited by the UK government in a policy paper in support of their vote against a proposed moratorium on some uses of neonicotinoids. Here I present a simple re-analysis of this data set. It demonstrates that these data in fact do show a negative relationship between both colony growth and queen production and the levels of neonicotinoids in the food stores collected by the bees. Indeed, this is the first study describing substantial negative impacts of neonicotinoids on colony performance of any bee species with free-flying bees in a field realistic situation where pesticide exposure is provided only as part of normal farming practices. It strongly suggests that wild bumblebee colonies in farmland can be expected to be adversely affected by exposure to neonicotinoids.

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