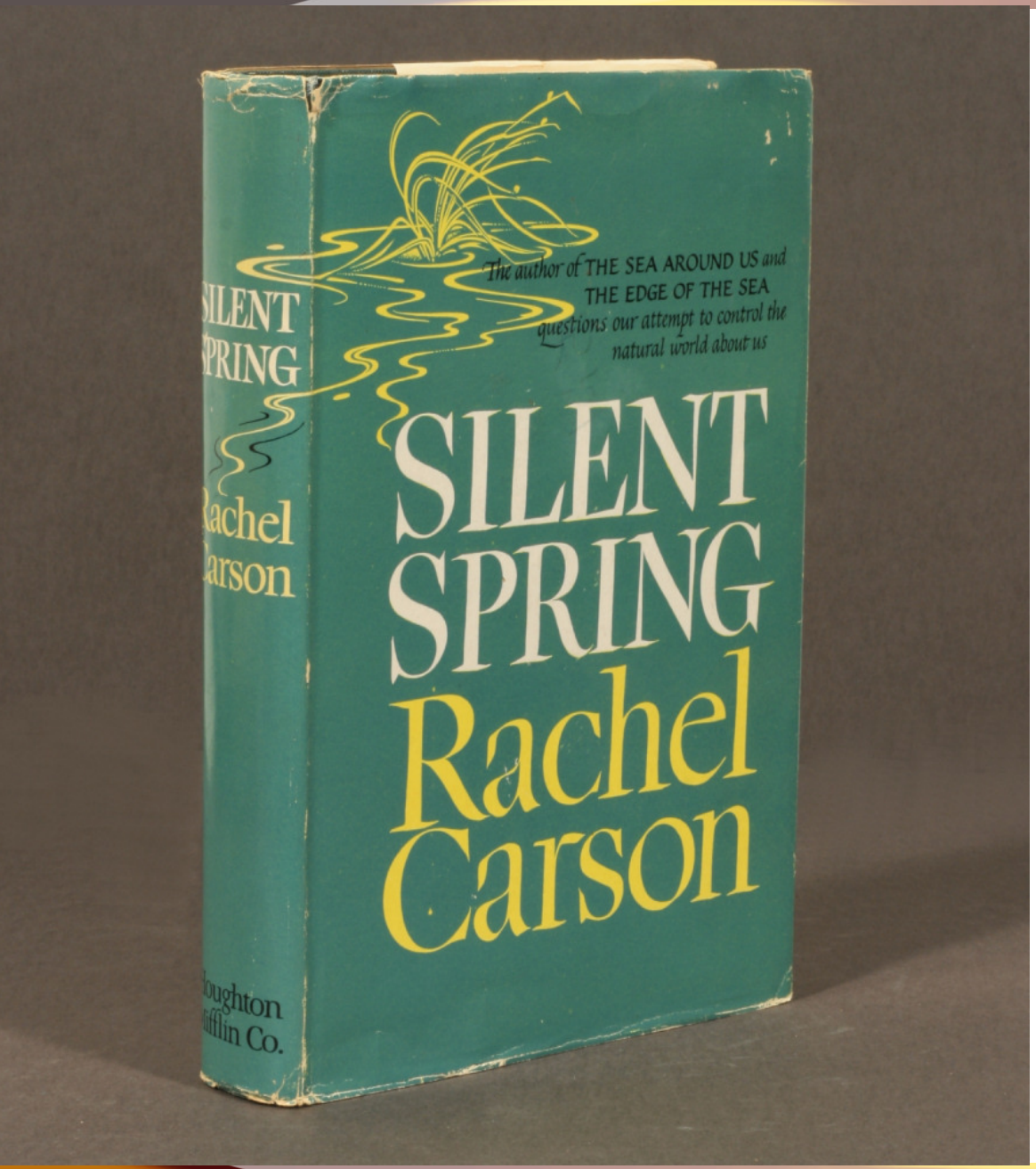
Dag van de omwonende: Bollenboos 28 september 2013 Diever

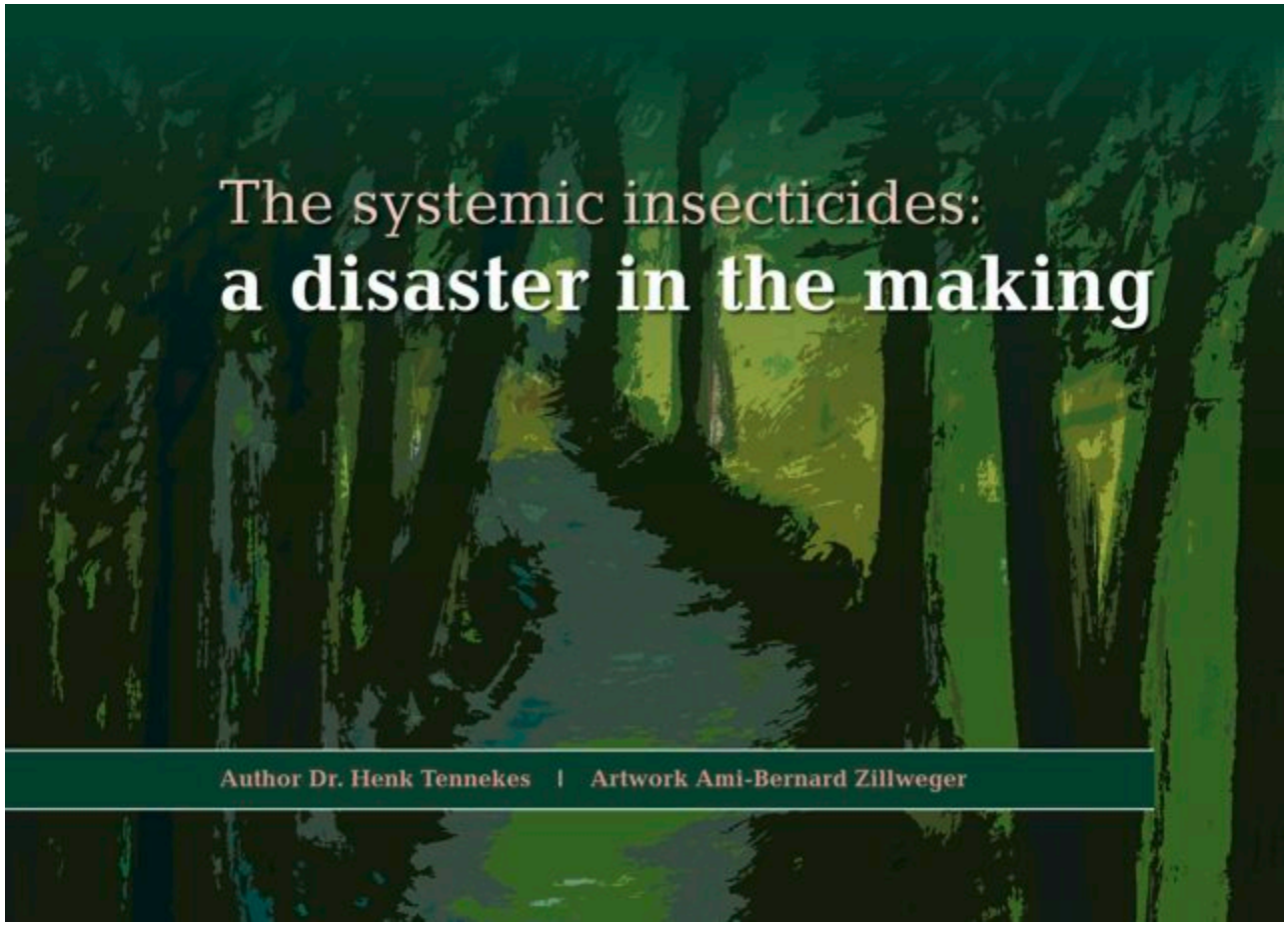
Neonicotinoiden: risico's voor bijen (en mensen?)

Dr. Jeroen P. van der Sluijs

Copernicus Institute, Utrecht University


SILENT
SPRING
Rachel
Carson
The author of THE SEA AROUND US and
THE EDGE OF THE SEA
questions our attempt to control the
natural world about us
SILENT
SPRING
Rachel
Carson
Houghton
Mifflin Co.

1962



Boek dr Henk Tennekes

www.disasterinthemaking.com

Europees onderzoeksproject ALARM:

De wereldwijde achteruitgang van bestuivende insecten is een grote bedreiging voor de biodiversiteit

Oorzaken zijn ondermeer: ***nieuwe pesticiden****, veranderend landgebruik en klimaatverandering* http://www.alarmproject.net

2013

Parallel Declines in Pollinators and Insect-Pollinated Plants in Britain and the Netherlands

2006

J. C. Biesmeijer,[1]* S. P. M. Roberts,[2] M. Reemer,[3] R. Ohlemüller,[4] M. Edwards,[5] T. Peeters,[3,6] A. P. Schaffers,[7] S. G. Potts,[2] R. Kleukers,[3] C. D. Thomas,[4] J. Settele,[8] W. E. Kunin[1]

Despite widespread concern about declines in pollination services, little is known about the patterns of change in most pollinator assemblages. By studying bee and hoverfly assemblages in Britain and the Netherlands, we found evidence of declines (pre- versus post-1980) in local bee diversity in both countries; however, divergent trends were observed in hoverflies. Depending on the assemblage and location, pollinator declines were most frequent in habitat and flower specialists, in univoltine species, and/or in nonmigrants. In conjunction with this evidence, outcrossing plant species that are reliant on the declining pollinators have themselves declined relative to other plant species. Taken together, these findings strongly suggest a causal connection between local extinctions of functionally linked plant and pollinator species.

2011

PNAS

Patterns of widespread decline in North American bumble bees

Sydney A. Cameron[a,1], Jeffrey D. Lozier[a], James P. Strange[b], Jonathan B. Koch[b,c], Nils Cordes[a,2], Leellen F. Solter[d], and Terry L. Griswold[b]

[a]Department of Entomology and Institute for Genomic Biology, University of Illinois, Urbana, IL 61801; [b]United States Department of Agriculture-Agricultural Research Service Pollinating Insects Research Unit, Utah State University, Logan, UT 84322; [c]Department of Biology, Utah State University, Logan, UT 84321; and [d]Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois, Champaign, IL 61820

Edited* by Gene E. Robinson, University of Illinois, Urbana, IL, and approved November 24, 2010 (received for review October 3, 2010)

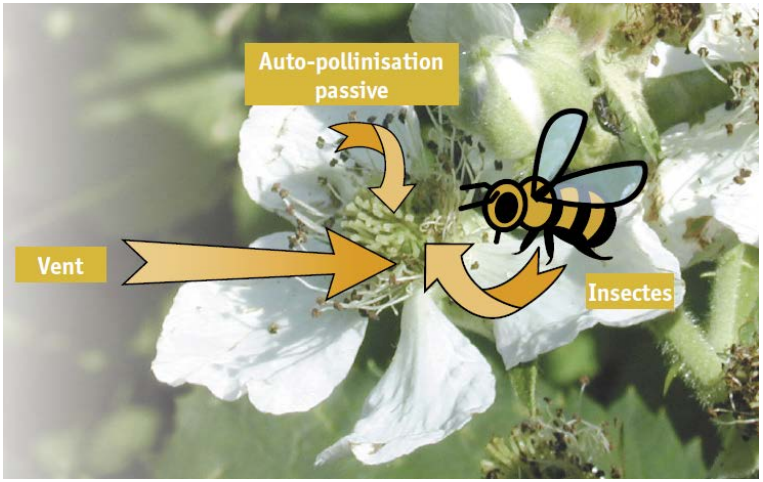
Bumble bees (*Bombus*) are vitally important pollinators of wild study in the United States identified lower genetic diversity and intensive nationwide surveys of >16,000 specimens. We show that the relative abundances of four species have declined by up to 96% and that their surveyed geographic ranges have contracted by 23–87%, some within the last 20 y. We also show that declining populations have significantly higher infection levels of the microsporidian pathogen *Nosema bombi* and lower genetic diversity compared

2011

Een nieuwe bestuivende soort in opkomst in China

Het belang van bestuivers

- >90 belangrijke voedselgewassen (35% wereld voedsel productie) heeft bestuivers nodig.
- Voedingstoffen vit A/C/E, anti-oxidanten, lycopeen, foliumzuur: 90-100% van dierlijk-bestoven gewassen
- Nederland: 3,8 miljard Euro / jaar
- 87,5% van alle bloeiende planten: dierlijke bestuiving vereist voor voortplanting en evolutie



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

Wereldwijd ca. 25000 bijensoorten

NL: 358 waarvan 181 op rode lijst

Terugloop bestuivende insecten: samenspel van elkaar versterkende oorzaken

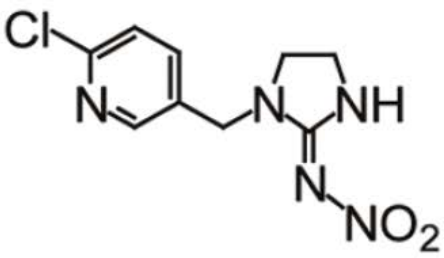
PPPP

- **P**ollen
- **P**athogenen
- **P**esticiden
- **P**lekjes (nestgelegenheid)

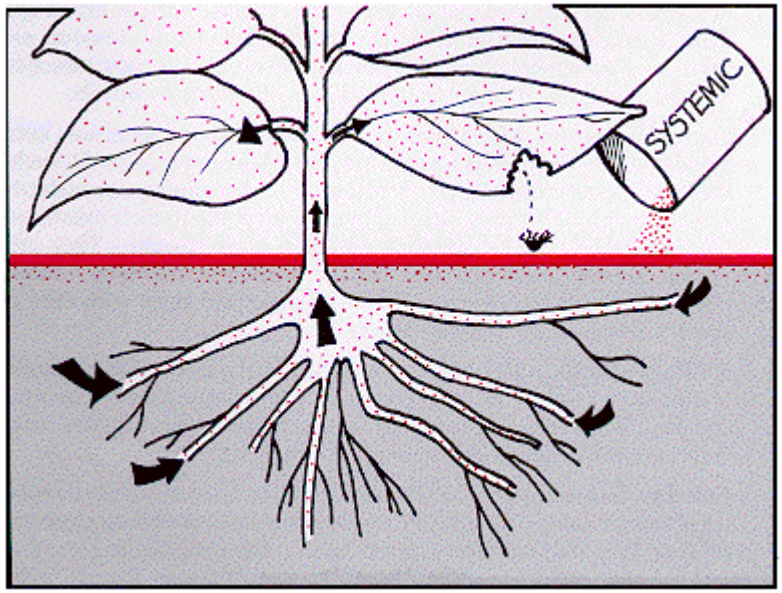
monocultuur

Systemische insecticiden: revolutie in gewasbescherming

Shinzo Kagabu



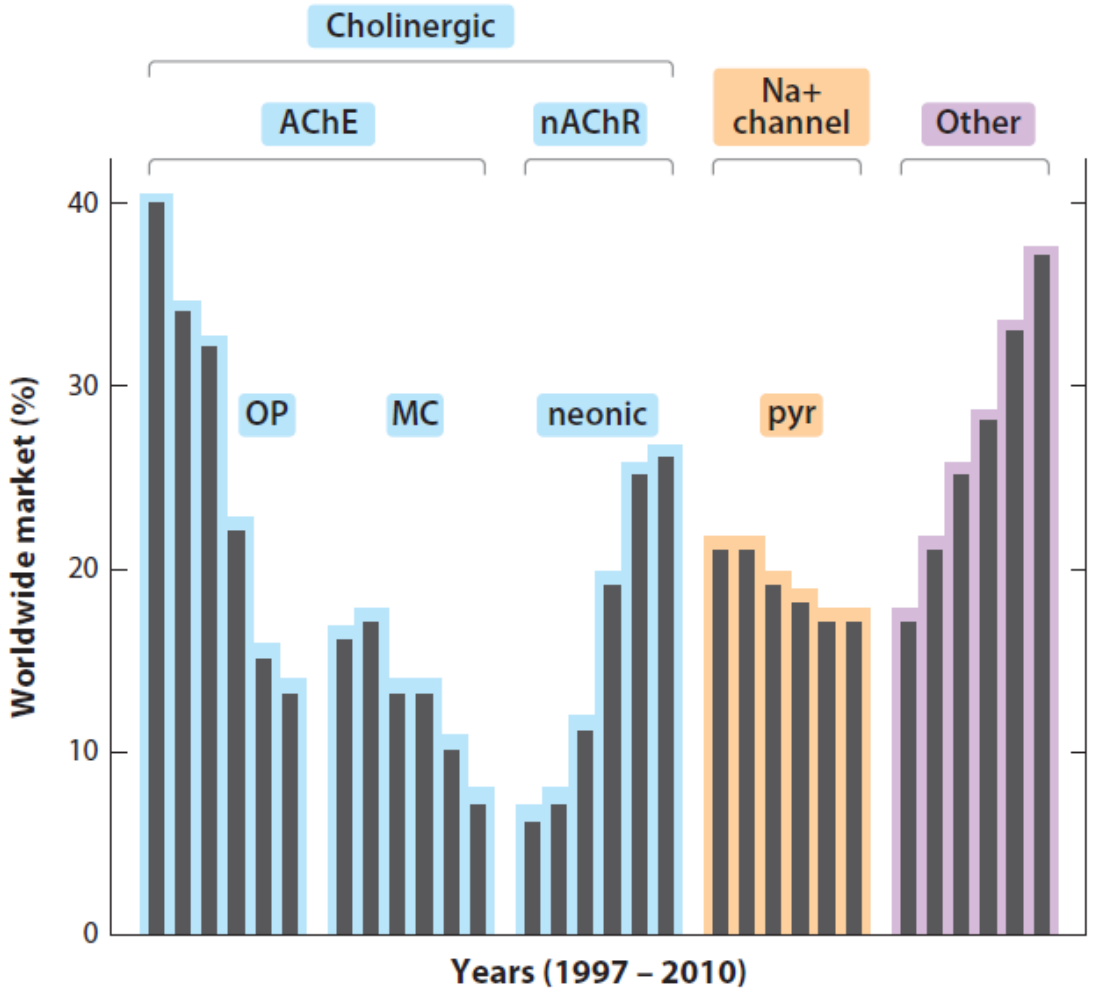
imidacloprid (1991)



Systemisch = gewas neemt gif op in de sapstroom, maakt plant van binnen uit giftig

Professor Shinzo Kagabu ontving van **American Chemical Society de Internationale Onderzoeksprijs voor Agrochemie 2010** als erkenning voor zijn uitvinding van imidacloprid (IMI) en thiacloprid, waarmee het **neonicotinoiden tijdperk van *systemische* gewasbescherming aanbrak**.

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



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

Imidacloprid 2010 World production: 20,000 tonnes

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

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).

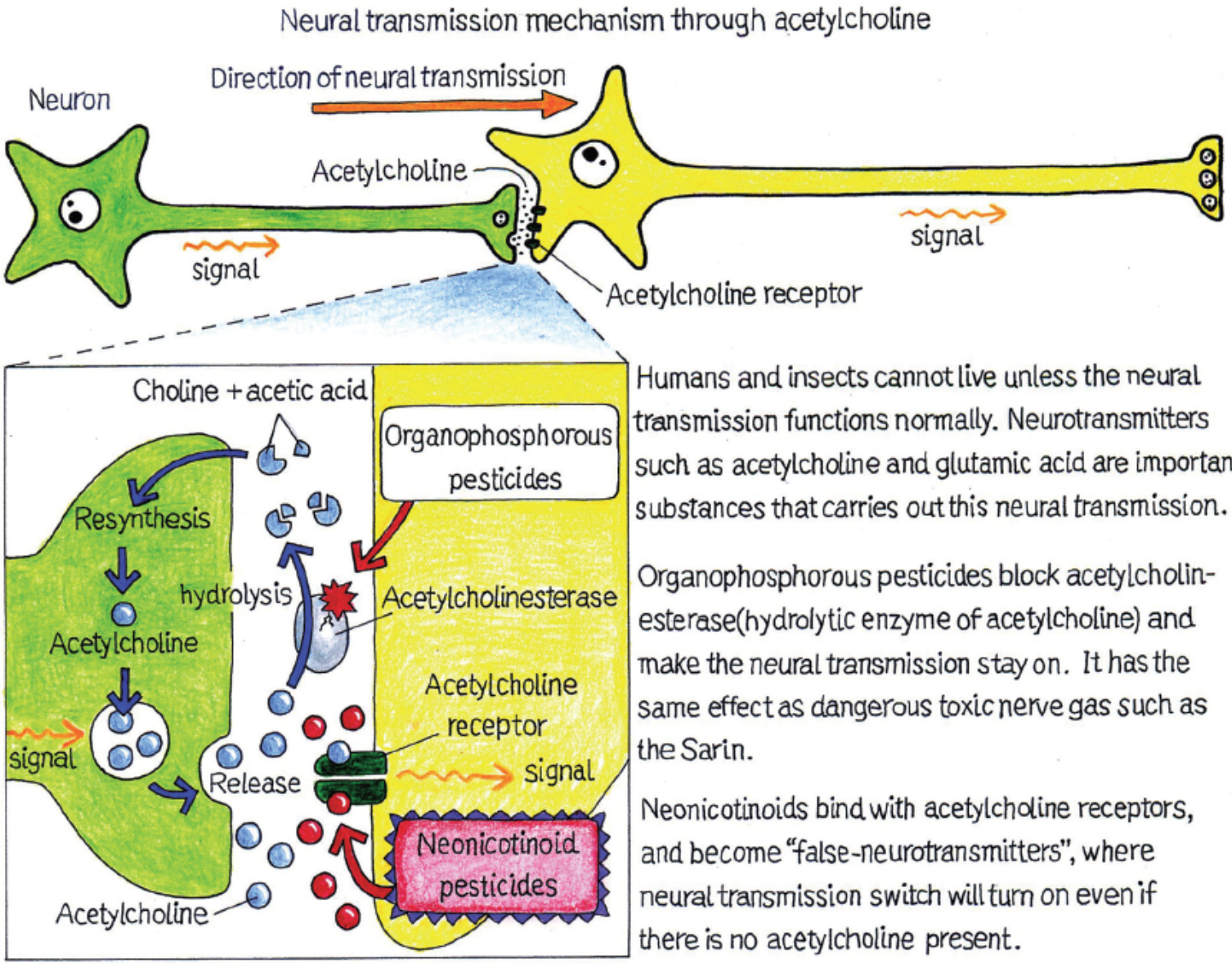
Giftigheid van neonicotinen t.o.v. oude middelen

Pesticide	®	Gebruik	LD50 (ng/honingbij)	Giftigheidsindex t.o.v. 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

Neonicotinoid / Organophosphorous pesticides disrupt the neural transmission



Humans and insects cannot live unless the neural transmission functions normally. Neurotransmitters such as acetylcholine and glutamic acid are important substances that carries out this neural transmission.

Organophosphorous pesticides block acetylcholin-esterase(hydrolytic enzyme of acetylcholine) and make the neural transmission stay on. It has the same effect as dangerous toxic nerve gas such as the Sarin.

Neonicotinoids bind with acetylcholine receptors, and become "false-neurotransmitters", where neural transmission switch will turn on even if there is no acetylcholine present.

Illustration: Saori Yasutomi

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

Systemische insecticiden

- Residuen in nectar en stuifmeel
- Zeer krachtig zenuwgif voor bijen, hommels, vlinders
- Hoge persistentie in bodem en water
- Afbraakproducten ook krachtig zenuwgif voor bijen
- Acute effecten (overdosering, zaaistof, spuitschade…)
- Subletale effecten
- Stapeleffect bij herhaalde blootstelling (chronisch)
- Risico in het veld hoog: PEC/PNEC >> 1
- Wederzijds versterkende werking met andere pesticiden
- Wederzijds versterkende werking met ziekteverwekkers

- **Belangrijke factor in de verzwakking van bijenvolken**

Pomurje, Slovenië April 2011,
Zaaiperiode clothianidine maïs

Schade 2500 volken dood

> 100 miljoen bijen

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*]

[1]School Natural Sciences, University of Stirling, Stirling FK9 4LA, UK. [2]Lancaster University, LEC, Lancaster LA1 4YQ, UK.

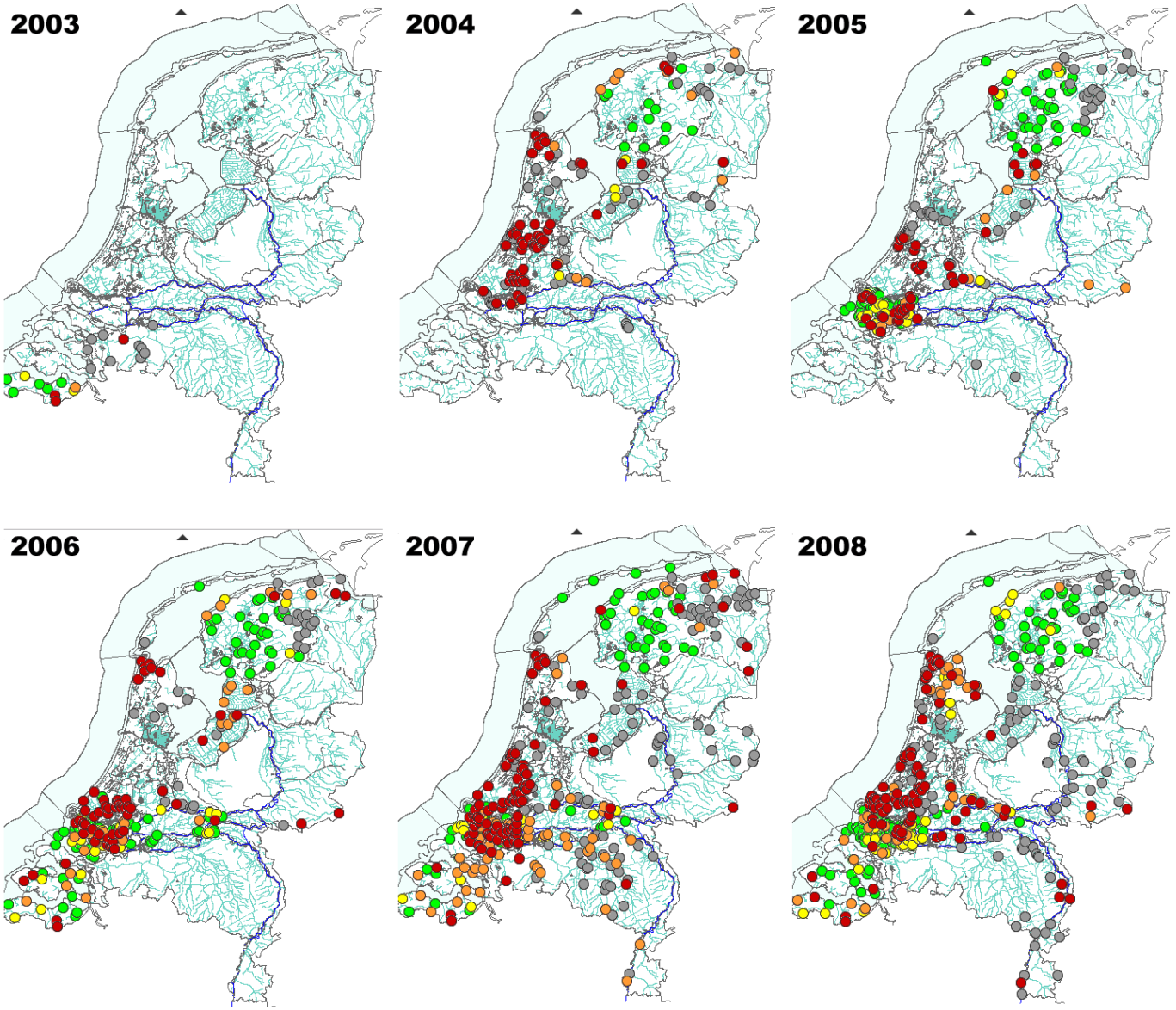
*To whom correspondence should be addressed. E-mail: dave.goulson@stir.ac.uk

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

Slechts 1.6 tot 20% van toegepaste neonicotinoiden wordt opgenomen door het gewas (Sur & Stork 2003)
80 tot 98.4% lekt weg naar bodem, en water!

Sinds 2004: Nederlands Oppervlakte-water zwaar verontreinigd met imidacloprid



EU verbod per 1 dec 2013

- 2 jaar verbod imidacloprid, clothianidine, thiamethoxam voor:
  - Toepassing op voor bijen aantrekkelijke gewassen (koolzaad, mais, peulvruchten, vruchtgroenten, fruit, asperge etc.)
  - Zaadbehandeling van voor bijen aantrekkelijke gewassen en verbod pneumatisch zaaien tijdens “vliegseizoen”
  - Over 2 jaar evalueren

Geen verbod voor: suikerbiet, aardappel, zadenteelt, wintergraan, gras, bladgroente, kool, wortel en knolgroenten, boomkwekerijen, fruit, sier/potplanten; bloembollen

Risico's voor mens?

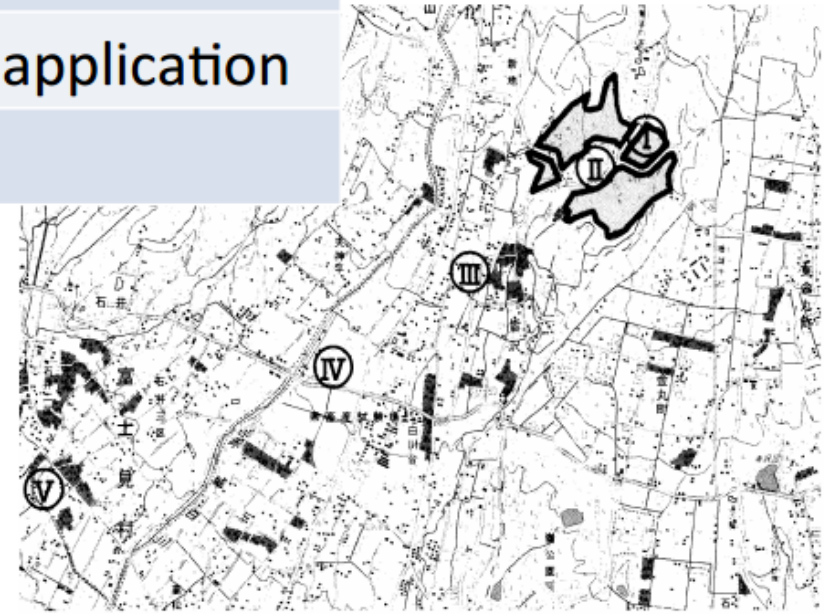
- Neonicotinoiden niet minder giftig dan organofosfaten
- Subacute vergiftigingen mens beschreven in Japan
- ADI normen verouderd (IMI 0.06 mg/kg = kennis van 2005)
- Japans onderzoek Kimura-Kuroda 2012:
  schade ontwikkelend brein ratten bij 1173x lagere dosis imidacloprid dan schildkliereffect waarop huidige ADI is gebaseerd.
- Autisme? Schizofrenie? ADHD??
- invivo versus invitro
- Parkinson (?)

http://www.actbeyondtrust.org/wp-content/uploads/2012/10/kuroda.pdf

2005年散布時の落下量

Acetamiprid deposits following the ground application

	Distance from the sprayed area (km)	Maximum Deposition (ng/cm2)	Interval after application (hr)
Ⅰ	0	311.7	During application
Ⅱ	0.5	11.2	During application
Ⅲ	2	1.31	6-8
Ⅳ	3	2.32	During application
Ⅴ	5	2.25	6-8



推定被曝量は、最大 84.1μg/kg体重
最小中毒量の0.28%

Estimated exposure dose is 84.1μg/kg BW
0.28% of minimum toxic dose

Ichikawa Y, Moriyama M, Motoyama N
日本農薬学会誌　33,281-288, 2008

Onderzoek dr. Kumiko Taira Symptomen subacute neonicotinoidevergiftiging

- Gevoeligste groep: niet-rokende vrouwen
- Trillende vingers (vuist-test)
- Abnormaal ECG (hartritmestoring, tachycardie: >100, bradycardie: <60)
- Geheugenverlies
- Hoofdpijn, schouderpijn, pijn op de borst, spierpijn
- **6-chloor nicotinezuur in urine**

http://www.actbeyondtrust.org/wp-content/uploads/2012/10/taira.pdf

OPEN ACCESS Freely available online

PLoS one

Nicotine-Like Effects of the Neonicotinoid Insecticides Acetamiprid and Imidacloprid on Cerebellar Neurons from Neonatal Rats

Junko Kimura-Kuroda*, Yukari Komuta, Yoichiro Kuroda, Masaharu Hayashi, Hitoshi Kawano

Department of Brain Development and Neural Regeneration, Tokyo Metropolitan Institute of Medical Science, Setagaya-city, Tokyo, Japan

Abstract

Background: Acetamiprid (ACE) and imidacloprid (IMI) belong to a new, widely used class of pesticide, the neonicotinoids. With similar chemical structures to nicotine, neonicotinoids also share agonist activity at nicotinic acetylcholine receptors (nAChRs). Although their toxicities against insects are well established, their precise effects on mammalian nAChRs remain to be elucidated. Because of the importance of nAChRs for mammalian brain function, especially brain development, detailed investigation of the neonicotinoids is needed to protect the health of human children. We aimed to determine the effects of neonicotinoids on the nAChRs of developing mammalian neurons and compare their effects with nicotine, a neurotoxin of brain development.

Methodology/Principal Findings: Primary cultures of cerebellar neurons from neonatal rats allow for examinations of the developmental neurotoxicity of chemicals because the various stages of neurodevelopment—including proliferation, migration, differentiation, and morphological and functional maturation—can be observed *in vitro*. Using these cultures, an excitatory Ca^{2+}-influx assay was employed as an indicator of neural physiological activity. Significant excitatory Ca^{2+} influxes were evoked by ACE, IMI, and nicotine at concentrations greater than 1 μM in small neurons in cerebellar cultures that expressed the mRNA of the α3, α4, and α7 nAChR subunits. The firing patterns, proportion of excited neurons, and peak excitatory Ca^{2+} influxes induced by ACE and IMI showed differences from those induced by nicotine. However, ACE and IMI had greater effects on mammalian neurons than those previously reported in binding assay studies. Furthermore, the effects of the neonicotinoids were significantly inhibited by the nAChR antagonists mecamylamine, α-bungarotoxin, and dihydro-β-erythroidine.

Conclusions/Significance: This study is the first to show that ACE, IMI, and nicotine exert similar excitatory effects on mammalian nAChRs at concentrations greater than 1 μM. Therefore, the neonicotinoids may adversely affect human health, especially the developing brain.

Verder lezen

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